ENCYCLOPAEDIA OF EDUCATION FOR 21ST CENTURY SERIES

EDUCATION VIA INTERNET

Edited by

S. Venkataiah

Mass education could hardly be achieved without applying the methods and tools of the new educational technologies based on information and communication technology (ICT). Education and training in organisations is an area where ICT is widely used.

The idea of uniform interface is central in the Internet concept—using the Internet concepts and principles in organisations, creating institutional webs of information, applying learner modelling and intelligent Internet agent technology. One of the main design principles of computer-based learning environments is the principle of interactivity.

This book covers valuable information on a number of issues on the subject. The whole information is grouped in ten chapters namely—learning over the internet; web-based training; interactive distance learning over the internet; internet in social studies instruction; interactive multimedia; internet education; distance program via internet; desktop video conferencing and internet; interactive technical documentation; computer literacy courses etc.

ISBN 81-261-0797-9

EDUCATION VIA INTERNET

Encyclopaedia of Education for 21st Century Series

EDUCATION VIA INTERNET

Edited by

S. Venkataiah

Library
Calcutta
25/3, B. C. Road

ANMOL PUBLICATIONS PVT. LTD.
NEW DELHI - 110 002 (INDIA)

ANMOL PUBLICATIONS PVT. LTD.
4374/4B, Ansari Road, Daryaganj
New Delhi - 110 002

S.C.E.R.T. W.B. LIBRARY
Date 9.10.2001
Accn. No. 10184

371.33
VEN

Education via Internet
© Reserved
First Edition, 2001

ISBN 81-261-0797-9

PRINTED IN INDIA

Published by J.L. Kumar for Anmol Publications Pvt. Ltd.,
New Delhi - 110 002 and Printed at Mehra Offset Press, Delhi.

Contents

Preface vii
1. Learning over the Internet 1
2. Web-based Training 21
3. Interactive Distance Learning over the Internet 54
4. Internet in Social Studies Instruction 91
5. Interactive Multimedia 98
6. Internet Education 139
7. Distance Program via Internet 228
8. Desktop Video Conferencing and Internet 233
9. Interactive Technical Documentation 242
10. Computer Literacy Courses 248
Index 259

Preface

The *Encyclopaedia of Education for the 21st century* has been created to provide access to information about contemporary topics in education. Practitioners and students at all levels in education have a need to know what is happening today, in addition to historical treatments within the literature. One of the significant features of each chapter is the inclusion of specific programmes, projects and activities so that the researcher can locate the literature as they desired.

The encyclopaedia will be of use to graduate and post graduate students in education and to practising teachers, administrators, librarians and planners.

The contents of this encyclopaedia is addressed to administrators, planners and educators working in the field of education and training with a view to stimulating interest and attention in the areas of education and its related fields. It is also addressed to a growing number of teachers and instructors who will be practitioners in education and who will need to be acquainted with the modern aspects of educational practice and development for the twenty first century. Many ideas, generalisations and discussions presented in this encyclopaedia should also prove useful to employing organisations committed to provide training facilities within their establishments—leading to effective mutual participation by institutions and organisations.

As education is the only device to mould the contemporary society in proper setting and to train the people to meet the current challenges, the present project is designed. With this changing scenario in different spheres of society, the educational developments are portrayed in the present work. Efforts are made to incorporate latest research in the concerned field.

We are grateful to all learned authors, whose writings are cited or substantially made use of in the present work. We are also thankful to all those who have helped us one way or other in compilation of the material. Last but not the least we are deeply beholden to Mr. J L Kumar, Managing Director, Anmol Publications Pvt. Ltd., New Delhi for undertaking the publication of the work.

Editor

1

Learning over the Internet

Mass education could hardly be achieved without applying the methods and tools of the new educational technologies based on Information and Communication Technology (ICT). In addition, ICT provides opportunities to set up and run business organisations that could help the countries overcome the existing informational, economic, cultural, geographic and other barriers.

The people involved in the process of globalisation and further internationalisation of the business also needs appropriate training and continued support. Telematics-based distance learning is considered as a possible answer to some of the new challenges for Bulgaria and the other CEE countries. Education and training in organisations is an area where ICT is widely used. As working needs new knowledge and skills, learning becomes an obligatory element of working.

The needs, constrains, and technological alternatives of learning support at work differ from those of school learning. For instance as the work situation is not static; the workers should adapt themselves to new circumstances and working methods. This means that two separated support systems should be updated continuously—the system for work and the system for learning. The team learning approach supported by a collaboration network is considered as a successful strategy. The concepts of learning while doing, just-in-time and just-in-place learning applied by using Electronic Performance Support Systems and Computer Supported Collaborative Learning systems are dominant in learning at the workplace, together with the emerging ICT-based flexible and distance learning strategies for corporate and professional training based on Internet and Internet functionalities.

Before designing the course, a model for flexible and distance learning was developed. The main principles and the most important characteristics of this model are determined by the choice of learner-centred instruction. Learner-centred pedagogy prescribes that the learner does not receive 'ready-made' knowledge. He should discover and construct his knowledge which does not mean that knowledge has to be reinvented. There are several other important characteristics:

— Learners participate in the formulation of learning objectives and take the responsibility for their activities. They can manage their own learning, cooperate with others, take part in negotiations and discussions. This makes them more motivated, self-directed and in search of personal efficiency. The student-teacher relationships are democratic ones; the students can even choose their teachers.

— Students get opportunities to construct their knowledge while solving real problems and transfer their knowledge to other students. They learn autonomously taking the responsibility for their own learning and following their individual cognitive styles, interests, and preferences. The students learn how to learn. The theoretical basis for constructivist learning are those of Bruner and Piaget.

— Teachers are mostly facilitators, ensuring the right educational resources at the right time. They also diagnosis the students' problems, and help them any time when needed. Formative evaluation of students' achievements and evaluation based on project outcomes is dominant. Teachers might be assisted by students-mentors who would help them and other students in using software tools.

— The problems students solve are formulated either by themselves or by the teacher and come from their everyday life and from the participants' professional practice The students and the teacher cooperatively solve these problems. The project pedagogy, based on the theory of Dewey and Kilpatrick and empowered by ICT, is considered as an alternative to lesson-based pedagogy.

— Space, time, equipment, and all teaching materials and information resources are used in an extremely flexible way. The curriculum and the teaching and learning processes are highly individualised. Different pathways, a wide choice over content and support for learning are offered to students who can progress with different speeds.

Most of the above mentioned principles give rise to some new developments in both educational science and technology, and provide a unique chance to fill the gap between the scientific studies and real educational practice.

The course 'Business on the Internet' follows a scenario combining the resource-based learning approach with individual learning. The teacher can be considered as a special type of resource. A repository of case studies and Group Decision Support Systems (GDSS) can be used for providing resources and on-going support for group role-playing and group decision-making. The informal discussion between learners can be considered as a special form of learning in so-called self-instructional groups formed by virtual learning communities inhabiting a virtual learning environment.

The World Wide Web (WWW) is built around three main ideas: physically and geographically distributed documents, unambiguous location of distributed documents, and a uniform interface. The idea of uniform interface is especially powerful because the user should not need to switch from one interface to another when using different data bases.

The idea of uniform interface is central in the Internet concept—using the Internet concepts and principles in organisations, creating institutional webs of information, applying learner modelling and intelligent Internet agent technology. One of the main design principles of computer-based learning environments is the principle of interactivity. The implementation of interactivity can be perceived as an art because it requires a comprehensive range of skills including an understanding of the learner, a deep understanding of software engineering, deeper knowledge about the contemporary instructional design principles, and aesthetical design of the multimedia interface.

Development of effective interactive learning environments will motivate and engage the learner. The most important characteristics of the contem-porary Web-based learning environments is the availability of virtual places: auditoriums, workshop rooms, cafes, libraries, etc., where students from different locations can meet, interact, and work together, as if they were face-to-face.

One such example is a Virtual Environment for Distance Education and Training (VEDET). The VEDET duplicates and extends some of the existing educational and training establishments and services and allows their better integration and enrichment. The VEDET offers a comprehensive metaphor and terminology to be used both for human-computer interface and instructional design purposes. Designing the Business on the Internet course some of the instructional activities are carried out at the virtual university and others in the virtual enterprise. These can be assigned to learners who then apply what they have already learned, e.g. doing marketing *research on* the Internet. This approach gives also a paradigm for restructuring traditional education and training by complementing it with a virtual component.

Although the course is based on an open syllabus, the curriculum development was carried out in accordance with some classical principles. The strategy was rather deductive, based on the overall strategy applied in the whole project. The empirical data and theoretical sources play a major role in the design process. All developed materials were published on the WWW and made available for all members of the project as well as for all researchers throughout the world for critical remarks and comments.

A modular approach was applied in the curriculum development. The course Business on the Internet is considered as an applied module of a ICT course that was divided into a basic module and applied modules. The introductory module of the ICT course aims at introducing the basic Internet services and within this module the students master Internet literacy and more, This part of the course helps students, that are novices in the Internet, to get comprehensive information about computer networks, the whole Internet and its applications.

The business and economics module aims to illustrate how the basic ICT presented in the introductory module, could be used for doing business on the Internet. It was decided that the content would be subdivided into the following three main themes:

- *technological background - stressing* specific software and hardware applications, revising what students learned in the introductory module with respect to the application areas;
- *applying ICT to business activities inside the company*— corporate communications, human resources, education and training, administration, financing, manufacturing, customer services and support, goods and materials, etc.; *applying ICT to business activities outside the company*— advertising and marketing, banking and payment, stock exchange, buying and selling, legal issues, etc.

The students should learn how to set up a business on the Internet and how to use it for communication, sales, marketing, research, human resource development and customer relations. The main goal of the course is to encourage students to set up their own learning direction, and to give them more control over the learning process. The final projects will serve as the most valuable output from the course. Students should demonstrate their ability to use specific skills and to participate in discussions. As a result of this course, students will be able to:

- apply methods of sell products and services via the Internet;
- evaluate the quality of services and products offered on the Internet;
- develop tools, methods and procedures for Internet business presence;
- do marketing research on World Wide Web (WWW');

- set up and use Intranet solutions;
- establish new buyer-seller relationships, e.g. links with clients, banks, other companies, etc.

The course is based on a combination of lectures, student presentations, self-learning, project work, and case study-based discussion. Students will have opportunities to learn from the best practice cases available on the Internet and to establish their own learning agenda.. Students will have opportunities for immediate feedback and they will be assigned as an expert in a particular area, e.g. marketing, finance, selling, advertising, etc., and asked to develop their own personal presence on the WWW.

A scenario for distance learning could include the following components:

- *registration—apart* from an especially prepared application form, the applicant can fill in relevant diagnostic instruments; the registration and diagnostic instruments will be delivered via ordinary mail, e-mail or WWW;
- *introduction—the* tutor introduces himself to learners, presents the outline of course, timetable of activities, the system of evaluation, etc., this could be done in different modes: face-to-face, by asynchronous or on-line electronic conference;
- *breaking down of ice—the* tutor invites the participants into the virtual auditorium and initiates mutual introductions;
- *announcements—the* tutor announces where and how the learners can find the learning resources attached to the course, e.g. in the virtual reading room, in the virtual library, in their personal virtual learning environments and also announces the place, the time and the topic of the first working seminar.

Further the tutor can build his own teaching strategy by combining different teaching methods, models, and activities:

- social interaction models
- models based on the information processing metaphor (concept attainment, inductive model, inquiry training model, advance organiser model, developmental model;
- personal source models (non-directive teaching, classroom meeting model, awareness training);
- models after Romiszowski (expositive classroom instruction, discovery classroom instruction, individual tutorial, group tutorial, seminar, workshop, open group discussion, resource-based learning systems, project-based learning systems, programmed self-instructional methods, instruction by *example: demonstration,* illustration and modeling, classical and operand conditioning, simulation techniques, case study method, role-playing, instructional games and simulation games);
- group dynamics methods (brainstorming, laboratory training).

Regular assignments will be announced throughout the course. Simple individual tests can also be offered from time to time. In addition there is a set of projects that will help students apply their professional experience and shape out their learning *experience. All* projects require group work and network communication via hypermedia documents, as well as designing and implementing such documents.

Two different pilot groups of learners are envisaged: regular students and managers in small and medium size enterprises. The first group is very homogeneous and consists of students from the University of Sofia. The managers will participate in the course in a distance delivery mode. The course will be experimentally offered to selected learners from the other Copernicus partner countries.

The course content will be flexibly linked with the students experience and will reflect the specifics of the Bulgarian situation. This will help learners participate more actively and autonomously in the learning process. During the pilot implementation the role of tutors will be taken by some of the university teachers who are also curriculum developers. They will also prepare the next phase of implementation when the course will be offered to a wider international audience.

For the course evaluation purposes four levels of training programme evaluation will be used:

a) *reactions of trainees — the* feedback about the level of satisfactory and difficulties experienced by the learners will be analysed;

b) *learners' achievements - will* be evaluated by using:
  - a set of tests to evaluate the learning results in terms of achieving the specified goals in terms of skills and knowledge;
  - the solutions of the business cases given to the learners;
  - the final assignment (the course project) requiring practical implementation of the Internet tools in solving a business problem;

c) *work behaviour - as* the analysis of the transfer of learning results in real work behaviour is a crucial point in the evaluation of the curriculum, this point will be specially observed in the pilot learning group of managers, when they go back to their real working environment;

d) *benefit to the organisation - will* be analyzed in the case of a pilot learning group of managers. It is expected that the organisations they manage should improve their performance in information retrieving, maintaining and distributing, and in everyday business applications of ICT. The managers can also take part in the evaluation of organisation performance and make the necessary changes supported by their course tutors.

In the evaluation phase the following approaches will also be used:

— *critical commenting:* some reviewers will go through the course and will offer their constructive criticism about fundamental matters of content, style and teaching strategy. The group of reviewers will include: subject-matter experts, tutors who are familiar with the learners, researchers participating in the project, learners who have recently studied on a similar course. Two types of evaluation checklists will be offered: a content evaluation checklist and the evaluation teaching effectiveness checklist.

— *developmental testing:* will involve trying out a lesson on sample learners and revising it before publishing the final version. The developmental testing will be done in two main forms: distance delivery (or face-to-face) trial and field trial.

All results in terms of learning achievements, teachers' and learners' satisfaction both by the courses and tools used and the transfer of learning will be analyzed and used for course improvement. A revised model of a flexible and distance learning system through telematics networks and an improved methodology for courseware development will be developed. These outcomes will be incorporated into an instructor's manual, as well into the student learning resource materials package.

The goal-based design concepts used to build a CD-ROM-based course for senior executives at Andersen Consulting. The course revolves around such abstract concepts as "quality management" and "continuous improvement." The key design components are

- Goal-based, problem- centered learning to drive the simulation of a real business environment.
- Video storytelling to create multiple, real-world perspectives on key issues.
- Quality management principles communicated with expert coaching specific to the course's problems.
- Thought- provoking feedback from experts that leads learners to evaluate and reflect on the "best" approach for dealing with complex business situations.

Multimedia learning applications have been accepted more and more by corporations as part of their overall training programs. These multimedia courses, whether delivered on CD-ROMs or through an Internet or intranet system, can teach a variety of skills, from software design to operating a cash register at a fast food restaurant.

One of the greatest challenges in using multimedia training technology, however, is applying the technology to the teaching of so-called "soft" or "abstract" areas, such as interpersonal relations. The design method used at Andersen Consulting Education, located in St. Charles, Illinois, to develop a multimedia learning environment that brings to life and makes concrete the sometimes abstract concepts of continuous service and productivity improvement to a targeted group of the firm's professionals.

The approximately two hour, CD-ROM-based, multimedia course is called *Improving Service and Productivity.* This course was built by Andersen

Consulting Education for senior executives in Andersen Consulting's Business Process Management organization.

Andersen Consulting's mission is to help its clients change to be more successful. To achieve this business goal, Andersen Consulting works with clients to define a strategy leading to the implementation of new capabilities driven by new processes, technologies, and improved human performance. Andersen Consulting also works with clients on much longer projects that typically last anywhere from five to 10 years. In these long-term engagements, known as "outsourcing" or "strategic sourcing" arrangements, Andersen Consulting's Business Process Management organization allows clients to focus on their core businesses by assuming responsibility for the clients' business processes, such as information technology, supply procurement, or financial operations. Moreover, in these outsourcing arrangements, a certain number of the clients' employees join Andersen Consulting. These new Andersen Consulting employees are part of a new service organization charged with reducing costs and improving quality for the client in the contracted areas.

The accounting department for a company are now working for Andersen Consulting and providing accounting services to the same company-that is, their former employer. This new service organization must meet its client's expectations, be aligned with the client's vision and marketplace strategy, and be aware of the market trends to provide leading-edge service. To deliver these services and provide value to its clients, Andersen Consulting must have satisfied employees, have processes in place to make continuous quality improvements, and continually understand what the client expects and faces in a particular industry. Over the years, Andersen Consulting's Business Process Management organization developed a variety of educational tools, techniques, and approaches that would help the executives running these outsourcing units to continuously improve service and productivity for their clients. Traditionally, these "continuous improvement" concepts were communicated in one-day seminars, which were expensive to run and dependent upon getting the most experienced senior executives to pass on their wisdom to others. In addition, participants at these seminars were often overwhelmed with the amount of information that was delivered to them.

Given the limitations of the lecture-based seminar format for teaching continuous improvement-related content, the Business Process Management organization came to Andersen Consulting Education with a request to design and build a computer-based, multimedia learning environment. The computer-based course would be a relatively small-scale project with an aggressive production timeframe of about four months. Moreover, an existing multimedia technical "shell" would be used for the product. This shell was designed primarily for knowledge dissemination in a linear fashion. We had to use existing code and did not have the luxury of using an artificial intelligence agent to make the product more interactive.

Instead of a standard menu of categories, we created business problems. Instead of topics, we employed an "investigate and decide" format. Instead of subtopics, we provided users with various textual resources and a video library of commentary and advice from Andersen Consulting experts and practitioners. In short, we took an existing multimedia shell and made it more educationally robust by employing some sound educational methodology.

Prior to designing the *Improving Service and Productivity* computer-based learning environment, Andersen Consulting Education worked with the Business Process Management sponsors to:

— Define the primary and secondary audiences for the course. This was important because the audience drives the type of problems, examples, and content that the course would eventually contain. It was determined that the primary audience would be those individuals who are currently running outsourcing units, and the secondary audience would be those individuals who might be running units in the near future. Therefore, the course content had to be real, had to resonate with these users.

— Identify a group of advisors who would help provide content and approve the course at several key milestone stages in the design and development process.

The Andersen Consulting Education team that worked on *Improving Service and Productivity for* approximately four months consisted of the *following*:

— Instructional designer: worked with the Business Process Management content experts to design a learning environment that met the needs of the audience and that was in line with the firm's current educational direction.

— Creative director: worked closely with the instructional designer and the content experts to develop a creative approach to the content. The creative director wrote the scripts used in the multimedia course and played a key supervisory role in the video production required for the course.

— Production group: was responsible for the graphics, the integration of the video and other content into the interface, and the certification of the product before it was released to users.

An important part of designing an effective multimedia learning environment is having a clear understanding of what "success" means after the product has been completed and delivered to users. Toward this end, Andersen Consulting Education and the Business Process Management organization worked closely together to define these key success criteria for the product:

- *Improving service and productivity* would be driven by the firm's formal approaches for gathering information, communicating with people, asking advice, and using continuous improvement management tools and techniques, among them being the ExPECT Model, the IMPROVE Model, and the Balanced Scorecard, as well as various internal employee and customer satisfaction surveys and process excellence methods.
- *Improving service and productivity* would be applicable to Andersen Consulting's outsourcing units worldwide, regardless of the type of service being provided to clients.
- Users would learn that techniques for improving service and productivity should become an integral part of day-to-day operations on an outsourcing unit.
- Users would understand that employee satisfaction and morale have an impact on the service delivered, which in turn affects the client's satisfaction.

In *improving service and productivity,* we wanted to design a learning environment in which users would have to make decisions and think about and learn from the consequences of their choices. Therefore, we wanted to create on a small scale a business simulation containing several realistic scenarios that would convey key concepts relating to improving service and productivity on an Andersen Consulting outsourcing unit.

The course's design has two primary educational components:

1) Goal-Based Learning. To leverage the power of the multimedia environment, we provided goals that we believed users would adopt willingly. Moreover, we allowed users to control the environment, giving them opportunities to gather different types of information from different sources in order to achieve their learning goals. We also created opportunities for users to reflect upon their actions. In other words, we "tossed" users into a business world where familiar problems exist. Users play the role of an executive leading an outsourcing unit where various problems must be solved. To reach this goal, users must *hypothesize* about what's wrong, *investigate* the problem to find its root cause, and then *decide* what to do about it. As users participate in this problem-solving process in the service of a goal, they:
   - — Acquire a rich knowledge base learned in the context of relevant real-world situations.
   - — Develop effective and efficient problem solving and/or critical thinking skills.
   - — Build their ability to recognize and solve similar problems that may arise in the future.
2) Expert Knowledge. The course provides a great deal of text and video information provided by Andersen Consulting experts and practitioners. These expert stories provide users with in-depth, real-world information on how a continuous service and productivity improvement approach or technique is implemented, as well as with advice on how to interpret a situation involving implementing or sustaining continuous improvement processes.

After we had settled on our educational approach, we needed to work with our content experts to determine some of the most common and important service and productivity problems that arise on outsourcing units around the globe. These three main problems were identified:

1) Client dissatisfaction due to a misalignment of expectations between the client executive and the end users of a service.
2) Low employee morale resulting in poor service.
3) Inability to meet efficiency targets due to a lack of a formal process improvement program and standards for measuring service gains.

The three main sections of the course are:

— The problem
— Get the Facts
— Decide What to Do

After we defined the design approach and determined the high-level problems for the user to tackle, we developed the storyline and business scenarios that would bring the multimedia course to life. We chose to set the business problems in a fictional mining company.

Like in a movie, we had to populate our business simulation with characters who would appear on video. One character is a guide who helps users navigate through the course. The other characters represent the perspectives of the client, the employees, and of Andersen Consulting. Actors were hired to portray the guide and the other characters.

For each problem in the simulation, we identified the questions a user might ask an expert in order to further understand the root causes of the problem or to receive advice on how to solve the problem. Before the experts were video-taped, they studied the course's scenario scripts. As much as possible, the experts' answers are specific to the problems in the course and are not abstract or generic.

Since we had to keep the learning environment fairly simple, the number of choices users have to solve the problems had to be controlled. But to maximize the learning, each recommendation was designed to be appropriate but not, on its own, necessarily sufficient to solve a problem. After users select an option, they receive expert feedback, which has two purposes:

1) To ignite users' curiosity in gathering more facts, and in doing so, learning more about Andersen Consulting's models and approaches for improving service and productivity.
2) To encourage users to try other possible recommendations.

Multimedia learning environments are just so much computer graphics if they are not compatible with people's powerful learning mechanisms. People have a set of expectations in their minds. These expectations fail to be realized. Then people either remember other experiences in which they failed in the same way, or they have to create a new set of expectations for how the world works. And then the learning process starts all over again. Instructional designers must emulate this natural learning process when building training.

According to Roger Schank, Director of Northwestern University's Institute for the Learning Sciences, training "needs to offer experiences that learners can store and label properly" in their memories. "Virtual learning scenarios-especially those constructed expertly on computers-use goals and plans so that memories can be stored at the proper level of abstraction". Improving Service and Productivity was designed to get the maximum learning advantage out of realistic storytelling-both the stories created through the use of fictional characters and the stories told by Andersen Consulting's own real experts. By working through the problem scenarios in the business simulations, users will add more stories to their memories. They can then draw upon these stories to solve service problems that they might encounter on an outsourcing unit in the future.

Different users come to improving service and productivity with different experiences, different knowledge baselines, and different learning goals. We suggest that they follow a particular sequence, but we don't restrict their navigational path through the course. We want users to get out of the course what they feel is most applicable to their respective job situations. Here is how the course is organized and what users see and do in the course.

A video guide appears on the first screen and welcomes users to the course, then explains the role that they are asked to play, and finally provides information about the case company. In this course, a user is placed in the role of "unit head" for a fictional client called L & G Mining, which is based in Wyoming. Then the video guide provides some useful background information about L & G Mining.

A user learns about the problem by reading a brief text message explaining why employee morale at L & G Mining is down. This low morale is negatively affecting service excellence at the unit. The video guide reappears, suggesting to a user that he or she may have already begun to guess about what could be the cause of the low employee morale, but that the user may want to gather additional information by clicking on the "Get the Facts" button. The material that appears once a user clicks on the "Get the Facts" button forms the heart of improving service and productivity.

After entering the "Get the Facts" section, a user learns the "four sides" to the problem being investigated. In the real world when service and continuous improvement issues arise, there is rarely if ever a simple explanation. The real world is complex, equivocal, and even contradictory. People make the best decisions they can based upon the available evidence. We try to make the "right" decision, often knowing that there is no absolutely right decision. After clicking on any of the first three buttons listed above, a user watches a video of an actor playing a character from either L & G Mining or Andersen Consulting. Each actor portrays one character's perspective of what's going on at the unit; that is, by watching the actors, a user can learn three sides to the story.

Andersen Consulting experts, who have had experience dealing with employee morale issues, provide their perspectives on what might be happening at L & G; that is, the firm's experts provide a fourth side to the story. There is both an educational and creative reason for giving users four sides to the story. From an educational standpoint, goal-based learning involves gathering facts from a variety of different sources to see if the facts support or contradict an initial hypothesis. From a creative perspective, telling different sides of a story is a traditional form of both oral and textual storytelling that has been used effectively by novelists and dramatists for centuries.

Finally, in addition to learning four sides to the problem, a user may learn more about a variety of Andersen Consulting approaches, principles, and tools that can be used for improving service and productivity from either watching videos featuring Andersen Consulting experts or by reading text organized by common questions that learners might ask.

S.C.E.R.T, W.B. LIBRARY
Date
Accn. No.

S.C.E.R.T. Library
Calcutta
23/3,

2

Web-based Training

The phenomenon of today's technology, especially Internet technology, has changed our daily life. Massive amounts of information can be reviewed through desktop computers. If your requirements are already clearly defined, a Needs Assessment may not be necessary. In that case, it can be replaced with a shorter meeting or series of conference calls designed to gather information and collect all existing training materials. This process usually occurs if you are ready to proceed with a specific project and are able to provide detailed information on all of the following:

— Project description

— Project scope

— Audience profile

— Current platform deployment

— Desired delivery environment

— Desired treatment approach

— High level content outline

After the Needs Assessment or meeting/conference calls, the final decisions are made on the delivery method and scope for the course. Armed with this information, the design team will provide a price for the Content and Design phase of the project. The Content and Design phase results in the delivery of a Course Architecture and

Design Blueprint. Together they specify what will be taught and how it should be presented. The Course Architecture is a detailed outline of instructional material that has been sequenced and structured (for example: modules, lessons, and topics). It describes:

1. What you want to teach?
2. What teaching sequence should be used?. What is the best course structure?

Here's how it works:

- Instructional Designers meet with the Subject Matter Experts (SMEs) to extract all of the course content, existing or new.
- The design team puts the information about job tasks and job knowledge gained from these meetings to work to help design the hierarchy of learning objectives.

Before proceeding to the Design Blueprint, it is necessary to be certain that the content is both thorough and accurate. The appropriate manager must provide approval, indicating acceptance of the Course Architecture "as is," or "with changes."

Once the Course Architecture determines what needs to be taught, the Design Blueprint specifies how it will be taught.

- Designers work with the artists and programmers to define the creative treatment (look and feel) and plan the instructional, presentational, and navigational strategies.
- The team prescribes the menu functionality and designs the viewer interface screens based on audience and content needs.

The team selects and define key components and their functionality (such as a mastery test, record keeping, index, and glossary). The team creates flowcharts detailing possible pathways through the course. All of this information is put together in the Design Blueprint. It, along with the Course Architecture, becomes the "blueprint" for the training project. After review and approval of the Design Blueprint, a price for the production and delivery of your product can be determined.

In addition to the instructional design blueprint, the Engineering Design phase specifies the hardware and software delivery systems that will be used to deliver the course. The engineering team reviews the options of the playback systems for course delivery considering your organization's available multimedia computer systems and online connection speed.

The engineering team defines all the software development tools to be used on the project including specific authoring languages or systems, graphics packages, and audio editing tools. The engineering team specifies how the course will work at a detailed level. Course navigation, required media elements, and any other technical issues are carefully considered. All components of the engineering design are clearly articulated. The course is designed to be error free from the start, a much less costly alternative than finding errors later.

The development and delivery of a Rapid Prototype constitutes the third phase. The Rapid Prototype demonstrates the planned look and feel for the course along with expected course navigation functions and sample screens. It is implemented using the software to be used for the final course and is delivered on the actual hardware you plan to use. The Rapid Prototype allows us to make any necessary changes to the production plans before launching into full-scale production.

In certain circumstances, a more extensive prototype may be needed to fully prove the course concept. In that event, we will story-board and implement in software a complete instructional unit exactly as it will appear in the final product, inclusive of actual, approved course content.

Following the Content and Design and Rapid Prototype phases, instructional designers begin story-boarding the course. A story-board is a written plan for a discrete unit of instruction, usually referred to as a topic. Developed with a special template customized for your project, a story-board is typically 5 to 20 pages in length depending on the duration and complexity of the topic. A typical course may have 30 or more storyboards. Storyboards include:

- A description of the overall scene and action for the topic.
- Narration scripts for spoken audio voiceover.
- Onscreen text that the viewer will read.
- Quiz/test questions with feedback.
- Descriptions of visuals to be displayed (video, animations, and graphics).
- Descriptions of music and sound effects.
- File names for all multimedia elements.

Storyboards are delivered to you for editing and approval. There are no surprises you will see only content and design treatments that you have previously approved. One way to measure perfection is how closely the final product matches the approved storyboards.

A production pathway, based on the seven production phases, is a definable and repeatable process. With input from the entire project team, the Project Manager customizes this process for each project. A Pathway Document is created that facilitates the accurate and timely completion of all production tasks. This document reflects adherence to Instructional Systems Development principles. Not coincidentally, this process parallels practices in the best manufacturing plants.

Specifies procedures and standards for each of the production phases relevant to your project. Defines the day-to-day logistics to be used by the team for producing, storing, transferring, archiving, and assembling all of the video and audio elements of the program into a finished product. Using the Pathway Document, together with the approved storyboards, the project team gets to work. The artists and animators create the visuals; the video producer shoots and/or edits live action footage: the audio engineer records the narration; and the music and sound effects are identified and produced. As the components are finalized, programmers assemble them to create a "beta" or test version of the product.

The purpose of Usability Testing is to see how representative learners from the target audience interact with the Rapid Prototype. Testing can be done formally, in a usability lab ... or... informally, within your company or training deployment site. Information from a usability test is invaluable in determining the effectiveness of the proposed training, including instructional strategies, ease of navigation, and user reaction to the overall look and functionality of the product. Usability testing, thought to be superfluous by some, is actually an essential "reality check."

Joy Mountford, interface guru, said it all in an interview. in Interactivity Magazine:

> "The most important thing to remember is that the user is never wrong. If they feel it's not good, if they feel it's uninteresting, if they feel it's difficult, then they're right."

Using the beta version to identify every possible interaction and pathway through the course, our Quality Assurance and Testing coordinator writes a testing plan for the product. Supervised by the coordinator, the testing team uses a database utility to record and prioritize any bugs they find while following the prescribed testing pathway. After two (2) passes through the program are completed, any bugs are repaired and the program is retested. After Quality Assurance and Testing, the beta course is delivered for final review (and in some cases, further Usability Testing) and approval before replication takes place.

ISD is a systematic approach to designing, producing, and evaluating multimedia-training programs using a series of logically sequenced steps.

1. Who is the learner? (audience profile)
2. What does the learner need to learn? (objectives)
3. What will enable that learning? (content analysis)
4. What is the best way to teach it? (instructional strategies)
5. How can we be sure it has been learned? (mastery testing)

Why use ISD principles as part of the course ware development process? Practiced effectively, this systematic approach minimizes the time, effort, and money needed for development, and maximizes the usage of these resources. Training projects in trouble can inevitably trace their woes to skipping or shortchanging one of the five key steps listed above.

Programs are produced without using the ISD approach (you've probably seen some). It's a sad fact because critical content is often omitted, while irrelevant content is included. When instructional strategies and delivery platforms are chosen by default the outcome is haphazard at best. It is not a pretty sight. Without ISD, testing is general rather than measuring specified and needed outcomes. There is a lack of cohesiveness across training curriculums, training goals, and testing. Finally, there is little or no attention given to assessing the effectiveness of the program or providing the means to keep it current.

Multimedia training, according to Rockley L. Miller, founder of the Interactive Multimedia Association, is reported by corporate users to have the following benefits:

- Reduced Learning Time—Multiple studies have found that interactive technologies reduce learning time by an average of 30 percent.
- The primary costs of interactive instruction lie in design and production—not replication, distribution, and delivery. With traditional instructional methods, the costs of training lie primarily in the delivery (instructor salaries, overhead, travel, etc.) and remain constant or even increase as more students place greater demands on fixed resources.
- Technology-based instru-ctional systems do not have bad days or forget to cover key points, nor do they cover the same material differently from class to class.
- With one-on-one systems, students are free to ask questions and explore areas at their own speed, without embarrassment or slowing down an entire class.
- Unlike normal classroom situations, an interactive system will not move on to new material until the current material is mastered.
- The process of interaction with material being studied provides strong learning reinforcement that significantly increases content retention over time.

- With interactive systems, students can explore any subjects from within the safety of the training environment.
- Interactive systems provide a level of responsive feedback and individual involvement that has proven to be highly motivating in both individual and classroom learning environments.
- Interactive systems can provide greater and more equal access to quality training. They can be used to simulate laboratory equipment that is typically too expensive to make available to each student.
- Interactive systems allow learners to take greater control of, and hence, responsibility for, their own learning process. Along the way, they discover that learning can still be enjoyable-even fun!

The power of any courseware can be augmented by web based training management. A good web-based training management system launches and works with web-based and CD-ROM-based courses. This tool can be customized for your company to:

- Provide convenient program distribution to multiple locations.
- Accurately manage and measure each stage of the program's execution.
- Broadly support advanced multimedia technologies streaming audio and video, animations,

To be effective, the web based management system must provide fast, easy access to courses for students and accurate, timely reports at a click of the mouse. To be responsive, the web based training management system must allow customized curricula, as well as changes and updates to the database from one central location.

Records of achievement (ROAs) and the use of portfolios as frameworks for the assessment of prior learning from work and other social and vocational experiences (AP(E)L) have become widespread over the past decade. Both potentially lay the basis for recognizing achievements previously beyond the reach of assessment. Both were intended to foster 'learning through success' not failure.

Both emphasize the notion of students as active learners responsible for their own development. When first introduced to education, both also emphasized personal achievement and development and centred upon the production of documents which represented not just an end in themselves but also a philosophy of education. This philosophy aims to raise levels of achievement by broadening the range of what is recognized as valuable and emphasizes the value of experiential, student centred approaches to learning. In particular the introduction of both ROAs and AP(E)L initiatives challenged the notion of formal examinations as a useful measure of achievement.

The early focus was on the personal gain to the individual resulting from going through the process of recording achievement. While the main aim was the production of a record detailing a range of achievements and learning, at the same time the process itself aimed to encourage individuals by building confidence in their achievements, helping them review their experiences, helping to plan and manage future learning, and by providing a basis for viewing learning as something they were a part of rather than something that was done to them. As the use of ROAs and AP(E)L grew more widespread, however, they began to change. In some cases the emphasis shifted from personal to public, from formative to summative. Instead of focusing on an individual's perceptions and personal achievements, some ROAs and AP(E)L portfolios began to contain ever more information about the skills, attainments and personal qualities in a form which aimed to be of use to prospective employers and admissions tutors. From a framework for promoting a developmental process they became almost an alternative 'qualification'.

This shift in emphasis from formative to summative resulted in a confusing (and confused) variety of attitudes towards the production of records and portfolios. In early initiatives the formative process was justification in itself. The shift in emphasis to the summative, however, posed the questions of what was being assessed and how and also potentially devalued the process underpinning the document. Today the development of AP(E)L systems in higher education goes alongside moves towards assisting students to reflect on their learning experiences to enable them to gain formal credit for informal learning experiences.

As the process gains recognition nationally and opportunities for crediting a wide range of learning increase, there is also increasing concern that such processes should have a degree of parity. The result has been a requirement that ROAs and AP(E)L portfolios conform to national quality standards. This sounds reasonable but marks a shift in emphasis, indicating that now the benefits of ROAs are for an audience outside the student not for the student themselves.

This paper outlines the background to recording achievement initiatives, summarizes the tension between the benefits of formative assessment and the requirements of summative assessment and identifies the issues which must be addressed if the tension is to be resolved. The Recording Achievement initiative developed at the same time as the introduction of the assessment and accreditation of prior experiential learning (AP(E)L) to formal education. Both were a response to the social and political context of the 1970s and 1980s. At the time the primary political emphasis in education and training was the reskilling of the workforce in the face of foreign competition and the need to adjust to changes in the way work is organized. The demand for more skilled labour and for skills which are often informally learned, such as personal skills, resulted in an education and training strategy which sought to recognize and accredit the widest possible range of educational achievement in the attempt to raise levels of attainment as a basis for a more highly qualified labour force.

The education system which existed in Britain in the 1970s had been designed to qualify only between 20 and 30% of the population and was equally ill fitted to providing either qualifications or routes to further training for those who had traditionally left school with no qualifications at all. Against this setting, practitioners with a philosophical interest in promoting experiential learning and student centred assessment were able to develop a number of local initiatives.

Records of Achievement provided the opportunity to recognize the achievements of young people who had traditionally been out of reach of educational assessment. AP(E)L enabled a similar process for mature learners to progress to further and higher education. Both provided a basis for a fuller account of the range of learner achievement as well as a way to recognize achievement which cannot be assessed with conventional methods of assessment. For a time, at least, policy objectives appeared to accord with the concerns of educationalists who wanted to broaden opportunity and promote experiential learning.

Recognizing a broad range of achievement was, however, only the first step to the policy objective of achieving a more highly qualified workforce. A tension soon developed between the aims of educationalists and the aims of policy makers as individual achievements summarized in ROAs and AP(E)L portfolios were looked at from the standpoint of providing evidence of ability to progress to further education or training, or as a basis for accreditation and formal qualifications. The need to accord with the public, externally defined criteria of higher education gatekeepers and employers was at odds with a focus on personally defined achievement.

The tension between the personal and the public in recording achievement was played out in the development of the National Record of Achievement (NRA). Local ROA initiatives emphasized formative processes and student centredness. Once local initiatives were officially brought together in the NRA, launched in 1991, the emphasis was on summative documents.

The drive to recognize and qualify achievement for a public audience also affected AP(E)L developments. At the same time as ROAs were changing to summative documents, moves to give prior experiential learning a semi-formal status as a basis for progression to higher education began to overshadow formative processes in AP(E)L in favour of satisfying criteria for public recognition and assessment. The NRA was designed to coordinate, and publicly document, student achievement through school, college, higher education and employment. In 1992 action planning was incorporated into the process. Although inclusion of action plans in the NRA is not mandatory, failure to do so may be interpreted in a negative way, a development which clearly indicates the move towards an emphasis in individual accountability rather than personal discovery.

The NRA is presented as a framework for managing the teaming process. It requires learners to summarize the outcomes of their formal and informal learning and identify actions taken as a result. The underpinning process requires reflecting on past experiences reviewing progress and action planning. This ostensibly represents an active learning process in which the young person takes responsibility for their own personal development - but if the document is really about personal development *per se* why does it have to be public and follow a nationally dictated format?

A prescribed format could be seen as being at odds with Kolb's notions of individual learning style. Producing an ROA, it is argued, provides a framework for developing skills beyond the academic - personal skills and transferable skills can all be included. Such transferable skills are common to all areas of academic study and include outcomes of learning and competences which in the past have been left unrecorded. They include skills associated with both individual and group working and range from the ability to make presentations to the application of computerized materials.

In all cases the student is encouraged to focus and reflect on their individual learning experiences in whatever settings they may occur. In doing this, however, and in requiring learner achievement to be summarized in forms which have employer currency, explicitly naming certain 'core' or 'transferable' skills for example, ROAs raise a number of methodological problems. Not only do they pose a tension between the benefits of the formative and the summative processes in ROAs, they also raise questions about the nature of transferable skills.

The concept of core or transferable skill is a problem. It has dogged developments in the post-16 field for nearly a decade and remains unresolved. There is a continuing debate about the transferability of skills from one situation to another, particularly about problem-solving skills at higher levels. Findings on comparative studies between novices and experts in several fields appear to suggest that many cognitive abilities used in the conscious processing stage are domain specific and not generally transferable'. A related debate about issues in assessing core skills focuses on the problem of level as well as context. Wolf attempts to show that it is not possible to give meaning to a concept independent of the context in which it is practised. She further argues that it is difficult to give any general meaning to levels of problem solving or communication. From this we could argue that attempts to name and assess core skills independently of context, as in the NRA, may be meaningless.

By 1995 a growing number of young people entering higher education had completed an NRA or ROA. Over the last five years increasing numbers of mature students have also gained entry to higher education through AP(E)L and the submission of portfolios summarizing their prior achievements. The idea of a common format for recording achievements for higher education is gaining ground. The Record of Achievement is also potentially useful for professionals as a framework for Continuous Professional Development. In this case it might be referred to as a portfolio of professional practice rather than a Record of Achievement, but it is still engaged in promoting the same reflective process,

An ROA for higher education could be viewed simply as a logical step to extend what already exists. Some higher education courses have used such frameworks for managing learning for many years - largely BTEC awards and vocational courses such as initial teacher training, occupational therapy or physiotherapy. On such courses the demonstration of active learning takes various forms and may include a daily log or diary of work with school children, patients or clients and includes the assessment of progress made by the individual in their relationship with these groups. In completing the record for assessment the student has the opportunity to demonstrate their 'transferable' skills appropriate to a possible future career. The establishment of the national Record of Achievement in schools means there is already a proportion of students entering higher education who are used to reflecting on their past learning experiences, whether formal academic studies or informal activities. Such students are able to assess their learning by reviewing their progress over all aspects of their course. They are also able to identify tasks and plan future study. This involvement in decision making enables students to gain confidence and carry over transferable skills gained through recording achievement to future learning. It also builds an expectation that the process will continue.

If the student progresses to a vocational course this expectation is usually met in the production of professional portfolios or similar documents. For students embarking on non-vocational degree courses, however, the process may not be available. A range of personal and transferable skills may be lost unless recording achievement can be incorporated, either by integrating recording achievement into the framework for personal tutor systems or subject-based monitoring procedures, or by introducing institution-wide profiling schemes available to all students.

Alternatively the initiative to extend ROAs to higher education can be viewed as inevitably increasing the tensions between the educational aims of student centredness and the normative requirements of policy makers and employers. It has already been noted that the introduction of portfolios and profiling systems as frameworks for assessment in higher education should be based on a clearly identified purpose and the interests and involvement of all parties should be specified. True, a framework for recording achievement in higher education could have many benefits: providing a basis for tutorial work, enhancing student autonomy, promoting learner centredness, and providing a basis for the student to identify and present informally learned skills as well as academic learning to a future employer but the tension between these various aims should be recognised.

A formative process-driven document is not necessarily the same as one which presents outcomes in a way that employers can recognize. Moreover, a personal formative document is almost by definition not the same as a summary of achievement which accords with nationally recognized criteria. This contradiction must be consciously managed if an ROA for higher education is to be either useful or effective. A number of formats for a higher education Record of Achievement have been proposed. The attached Summary Record of Achievement is based on papers already published by BTEC and UDACE which identify learning outcomes.

Many of the learning outcomes are common to more than one subject area and echo the core or transferable skills identified by bodies such as the CBI, FEU and the NCVQ in the debate about developing core skills in the Post- 16 curriculum during the late 1980s and early 1990s. Learning outcomes proposed for higher education include the ability to manage and process information, to work cooperatively, to analyse and develop one's personal skills as well as act ethically and possess basic computer skills. BTEC have identified common skills relating to these outcomes which should be developed and assessed at each level in relation to their own qualifications.

The proposed record includes a summary sheet outlining the student's achievements in a range of skills which all higher education students would be expected to achieve during the course of their studies. This poses problems. First the methodology of recording such information is proving difficult, which is not surprising given the difficulties in defining what we mean by core or transferable skills, or more recently 'key skills'. Second the initiative must be clear about the aims of the record - are they formative or summative? These purposes should be clearly defined and stated in advance. If the aims are summative how do we counter growing criticisms that portfolios and records of achievements are not a basis for rigorous assessment? If the aims are formative how do we justify them?

One solution is to ensure that the credibility of any assessment is seen to be rigorous. Rigorous assessment systems need primarily to be reliable - results need to be replicable irrespective of the assessor or the context. Much of this depends on ensuring there is a focus on moderation, both internal and external, to agree standards and appropriateness of submissions. It also requires internal and external reviews and clearly stated outcomes against which achievement can be measured and assessed by both the students and their assessors.

Above all it requires 'socialization' of assessors so that standards and procedures become common currency. Exemplars can assist the moderation process and enable discussion to focus on issues such as the acquisition of personal skills and their summary in reflective diaries or logs. Matching of evidence to outcomes is not an exact science and assessors need to agree on what they see as appropriate and inappropriate forms of evidence of achieving given outcomes.

The SEEC guidelines (SEEC, 1995) are a relevant development. These guidelines are an attempt to ensure that everybody involved in recording prior achievements for assessment and accreditation in a higher education institution is working to similar quality standards. The guidelines have developed to promote rigour and accountability in AP(E)L procedures but, because of the similarity between them, are also equally appropriate for the summative recording of achievement in ROAs.

The guidelines require the assessment process to be transparent, with information available at all stages and levels of recording and assessment. While the guidelines clearly have relevance for the practice of accrediting prior learning and achievement, what the guidelines cannot tackle is the context in which ROAs (and AP(E)L) are developed and used. It could also be argued that the very emphasis on quality is, by implication, a contradiction of the original aims of AP(E)L. The emphasis on credit and academic quality negates personal development issues and student empowerment. The attempt to get our practices recognized means we conform with the very regulations and assumptions which AP(E)L once sought to challenge.

At present there is debate and concern about the notion of 'graduateness' and about the competence of graduates leaving higher education with degrees or other graduate qualifications. The HEQC is currently preparing its thoughts on the concept of 'graduateness' and how the meaning of the idea of a graduate has changed in relation to current employment patterns and policy initiatives. In addition to subject-specific knowledge and skills, new' graduates are also expected to acquire a range of transferable skills which will enable flexibility in a rapidly changing work environment. Such skills, especially at high levels, can only be recognized, recorded and presented when reflection has taken place. There have been fierce criticisms that this is purely an employer-oriented notion of 'graduateness'. On the other hand, it can be argued that the move towards profiling in higher education is a way of providing more effective support to individuals and enabling personal development for students who access HE from a variety of different routes.

Many vocational HE courses such as initial teacher training, occupational therapy, physiotherapy and social work courses already use this approach for assessing skills, although sometimes under a different name. In a number of cases the subject-specific criteria or competences are stipulated by relevant professional bodies, although significant staff development may be needed to enable education staff to understand, recognize and assess them. Within the current trend towards an emphasis on lifelong teaming and continuous professional development, the recording of personal and professional skills will undoubtedly increasingly extend to all vocational HE courses and across education and training in general. ROAs will become increasingly important.

Changes in teaching and learning with the new educational technologies indicate changes in design/ development of instructional materials. The impact of educational technology and its effects on students learning become even more important issues. Researchers argue that changes of technology attributes may not affect learners' cognitive and information processing. Students may benefit from the new techniques of presenting learning content through current educational technology.

We are able to communicate with others through electronic mail, video conferences, and chat lines without leaving our offices or homes. Recently Deep Blue, a super computer, defeated the world chess champion for the first time in history. Altris, a file management company, stepped forward to build software on the premise that document files have intelligence of their own. It allows users to be recipients of information without requesting it. Can we completely separate what technology can provide to us from what we can do with technology? Compared to the web, limits of each technology, including videotape and CD-ROM, certainly restrain our creative abilities in the design and delivery of our learning materials. We, as humans, have tried very hard to improve modern technology to provide quick connections, materials access, and interaction without boundaries and time constraints.

According to Schrage "The key is to remember that even as we use technology to shape our environment, technology is shaping us. Technology rearranges our perceptual world and subtly redefines our relationship with our environment". In a study by Internet Commerce, it reports that there are 34.6 million web users. We see the fast growing trend of using the web as a vehicle to deliver on-line educational programs. Educators should examine the approaches they choose for enhancing the learning process and make it as good, if not better, than conventional teaching methods in the classroom. This article discusses students perception on learning through Web technology, including class syllabus, professor notes, coursepaks, projects, tests, and self-paced learning courses.

The web technology permits us to represent the learning materials in any combination of media format, such as text, image, graphics, and animation (no sound and video clips were employed on the web pages during this study). This multimedia information environment can be accessed and displayed simultaneously. The survey was administered to the students who were taking the self-paced web units as a trial run for the new media. Forty six participants filled out an on-line survey when they finished the units. Eleven of them were interviewed at the end of their final test for the course. All interviews were recorded and transcribed by the researcher. The interview lasted from thirty minutes to fifty minutes. Qualitative data obtained in the interviews were analyzed using interpretive /descriptive analysis procedure. Both data were employed to assess how students' experience of using new media influenced their attitudes toward their learning performance.

The questionnaire and interviews indicated that using web-based instruction was a positive learning experience for the participants. The study indicated educational technology could offer a rich learning environment if we were able to integrate collaborative on-line environments, proper pedagogical design, and flexible user's interface. Web-based instruction was designed in such a way that learning materials were arranged into small modules, including presentation, examples, and exercises. Objectives were incorporated into each module so that learners could be aware of the learning expectation.

Preview and post-view questions for the learning content allowed students to analyze and evaluate their learning through each module. Students were presented with examples and exercises following reading paragraphs. Once they believed that they mastered the materials, they could move onto the practice test. There were links to an interactive learning environment. For each stage, a student was able to click on a more detailed explanation if he/she had any problems before proceeding. Auto feedbacks and diagnosis messages were incorporated in all parts of exercises. Students could evaluate themselves before they were ready for tests. They were able to communicate with the professor through email, chat room, and/or telephone. Following is a summary of the results.

All survey questions were on a Liker scale except items one to three. A majority of students (87%) had prior experience in using the web, which made implementation of web-based instruction much easier than what we expected. One-third of students had access to the Internet at home while others still came to use the campus labs. Students spent slightly less time studying a unit on the web (3-6 hours) than they did for the regular class. In general, the students were very positive about their experiences in learning through the web. The results indicated that the web-course not only met their needs but also helped them use time more effectively.

However, they were undecided when asked whether they preferred the electronic format or the traditional instructor lecture. Their hesitation and concerns were also echoed during the interview. The interview data agreed with the results of the survey. The students valued alternative learning styles that technology offerred. They praised the potential of technology to establish a feasible learning environment in higher education. However, they also addressed their concerns and limitation of educational technology.

The study indicated that the high level of interactively inherent on the web gave the users dynamic control of information. Interaction with linked information was very structured in terms of proficiency level and direction. The students preferred such full control over their learning situation.

> "I enjoyed it for a number of reasons. I could do it in my own schedule .... I could get back to review it which you couldn't do in a classroom."
>
> "I thought that it was helpful to have questions where you got immediate answers and you determined whether you're right or wrong. That helped me for a couple of incidents because I always

> tested myself and that kind of exercise reinforces what you are looking at."
>
> "I was going more in depth in the stuff that I didn't know. In a class sometimes, the professor has to go over it again if some people don't understand. With a computer, you have the control. It made it more personal for me."

Students also felt that the experience in working with web-based instruction offered the opportunity not only to learn the content but to learn how to use a computer and how to access Internet. The students were encouraged to browse other resources by being provided with course related links. They suggested that such hands-on experience was really beneficial.

> "Using the Internet - what a great learning tool! I had some computer experience before coming to this class but had never used the Internet. Having our reading on it made for a great experience for the entire class."
>
> "...for some people in the class it was difficult but they finally caught on. I am lucky to have my fiance~ teach me at home. We've had Internet access for some time but I've never been that interested in it until this semester. In another of my classes we get our notes and important material off the Internet. Some of my friends were jealous that we learned this in this class."
>
> " Allowed the students to experience technology. It is a very ingenious way to get people involved with Internet and apply what we learn to technology. "
>
> "It made me use a computer. It was nice not having to use pen/paper."

In traditional classroom teaching, we focused more on the students' performance based on the selected objectives. Web-based instruction permitted the meaningful learning which allowed students to choose self-exam exercises after the guided practice and to have an opportunity to construct their learning, to provide openness to new information and multiple perspectives.

> "I think that the program was effective. I like how there are questions throughout the reading because it tests how much I am retaining. The animation entertains me and the graphs help me to understand what is being presented. The test helped a lot because it helped me to feel more comfortable when taking the exam."
>
> "It took me a lot longer than I thought it would because I took so many notes but it was worth it."
>
> "The first thing I did was to take the practice assessment. That was a kind of pre-test for me, which showed me what I needed to study and which behavior objectives that I needed to concentrate on .... So I took extensive notes for the objectives that I needed to work on and I just scanned through the reading, and I did OK."
>
> "I feel that using a computer program helped me have a better understanding of the Epsilon mini-unit. The questions that follow the text really helped me understand the material. It seemed to go into more depth than in the classroom."

As we have learned, the World Wide Web is a universal medium that everyone who has an Internet access can use. It doesn't have problems with different platforms and can be accessed from anywhere in the world. The web is an international information delivery tool. Students' feedback regarding the class syllabus, professor notes, coursepak, and projects was extremely positive.

First, students liked to have the convenience in accessing their class information. They valued the opportunity to read and/or download the syllabus, professor's notes, or coursepak. Deadlines and test schedules through the web could be checked at any time. Instead of worrying about misplacing their hard copy of the syllabus and buying the coursepak, now they could turn to the web. Second, the study showed that students strongly appreciated their capability to obtain actual learning materials from the web without time and location boundaries, especially for people who worked full time. It not only saved them time from traveling to the campus but also offered flexibility for them to choose their own time.

> "I like it because I could do it any time I wanted to and it was easy to use."
>
> "I really liked that fact that I could work at my own pace at home. I did not have to worry about my notes not being adequate."
>
> "I work full time and I feel this gives me flexibility."

The web-based course provided non-linear access to resources links on the web which could be obtained rapidly and easily through multiple links and paths. Students could flexibly move among related elements of information and explored many related data/ideas in a non-linear format. Students liked the related links which broadened their learning beyond the classroom and also helped them obtain more information or real data, especially links to professional journals and organizations.

The only suggestion from students was to have more meaningful links. Some students actually went out and searched for the links that they would like to have. As one of the students described:

> "Internet offers us opportunities for self-direction and exploration. The more varied the cybernetic environment, the more possibilities exist for us to make connections, access materials and develop their own theoretical and practical postures as achievers. We are given opportunities to experiment and grow. We learn not just a few tricks of the keyboard but thinking strategies for connecting with rapidly changing technological landscape."

The learning styles and learners' characteristics have been the central concerns of educators. Each individual has a personality which effects his/her learning style. Some learning styles and personality needs can be particularly well addressed in a web-based learning environment. Some students who were not out-spoken were more comfortable working on web-based courses while others may have felt less pressure in such a format.

Web-based instruction may provide a learning environment which better meets learning needs. One student stated: "I thought the computer course took off a lot of stress because it could be done when we wanted." However, several disadvantages were identified by students, such as Internet traffic—a long waiting time to log on and/or to load some information, a lack of audio, and no face-to-face communication.

In 1995, Lansing Community College (LCC) started developing multimedia supported, Internet based instruction with CoNDUIT: http: // empire. lansing. cc. mi. us/ courses /mmlab. htm. Those materials were only usecl to supplement traditional and arranged courses until September 1996 when Dr. Sykes, President of Lansing Community College, announced that LCC would be offering a degree via the Internet starting Fall 1997 and appointed a committee to "make it happen." The Instructional Design Issues that were addressed in developing on-line instruction can be found at http:// empire.lansing.cc.mi.us/ courses /corstrct. htm. Typical workshop-developed on-line courses can be found at http:// empire. lansing. cc. mi. us /courses/hands - on.htm. The on-line degree offering can be found at http: //vcollege.lansing.cc.mi.us.

Key points from the Progress Report Presentation:

1. LCC decided that all on-line courses would use the Distributed Learning model where the student was

the center of the instruction model, not the professor and college services.

2. The task of developing an on-line degree was split into three parts: a) Launch and Sustain the LCC Virtual College Framework b) Identify Start-up Curriculum c) Develop and Deliver
3. The instructional design principles followed were adjusted for the media.
   - a) All faculty followed the same format for the introduction to their course
   - b) Faculty use a consistent set of navigation buttons.
     - i) Links for contacting the instructor
     - ii) Links to critical parts of the course
     - iii) Links to department offerings
     - iv) Links to student support services
   - c) A forum was used to establish a Learning community element in the instruction
4. Three Hundred four students enrolled in the 18 courses taught by 16 instructors and 411 seats were filled. Most of the students were from the LCC district.

There were some critical differences between students taking on-line classes and students taking arranged classes supplemented by Internet materials.

6. Support for an on-line degree
   - a) Student support
   - b) Faculty support
   - c) Hardware
   - d) Software

The major problems we encountered were:

1. Inexperience of everybody
2. The need for on-line registration
    a) Concerns of the registrar
    b) Students in on-line classes without knowing they had selected them!
    c) Students taking on-line classes because they wanted to eventually get a computer.

Difference of on-line students from traditional or self-paced students
    a) Extra time needed for the demanded individual attention
    b) Numbers of students that can be accommodated in one class
    c) Ability to communicate /demonstrate skills in ways students would understand.

4. Needs of faculty for technology support and the timing of technology support people
    a) Netscape capable machines
    b) Network connections for faculty
    c) Common sites for posting work
    d) Servers, addresses, programs changing even after classes started.

Need of the faculty to express their own individuality in their instruction and the need of the college to have consistency among classes for technology/ student support.

6. Need to keep this as another delivery option having the same content and quality as the traditional courses
7. Course coordination with traditional courses.

What worked:

a. Teams involving administrators, faculty, and support people making decisions together.
b. Templates for standardizing parts of the online degree courses. Pairing "new to technology" faculty with technology literate support
d. Having Virtual College Faculty meetings to share problems and progress.
e. Limiting class sizes to 20 and running classes with only 6 students
f. Appointing special advisors and technical counselors to support on7line students g. On-line student support j) Advising ii) Tutoring iii) Library materials iv) Ordering books, tapes, other materials v) Trouble shooting forum

8. Using a forum to create a learning community
9. Forming student teams to provide more student interaction

The verdict is not in yet on whether or not there are/will become a problem:

1. Double pay for faculty teaching for the first time on the virtual college
2. Running classes if only half the required number of students for traditional courses sign up
3. Multiple instructors for multiple sections using the same material

Computer-aided training, now particularly via the World Wide Web, plays an important role in the trends in training and development. Furthermore, interactive games can be a powerful motivating element in interactive multimedia learning environments. Understanding basic elements of game design as well as potential pitfalls in their introduction can make their use more effective.

There is no doubt that the World Wide Web of the Internet has exploded in popularity over the past few years. The trainer's dream of on-demand, distance learning has overcome a major infrastructure hurdle with the wide acceptance of the TCP/ IP (Transmission Control Protocol/ Internet Protocol) and HTML (Hypertext Markup Language) standards across all disciplines.

The pipeline exists and is viable. Simple text-based information, including hyper-linked Web pages and electronic mail, has been zipping across the wires for years. Images and sound add more dimension to the interactive experience. However, with the introduction of multimedia browser plug-ins such as Macromedia's Shockwave, rapid development, publishing, and accessibility of fully interactive, networked multimedia content is a reality. The days of developing interactive communications within cumbersome proprietary systems to be delivered on a single company's closed wide area network to constraining, unsupportable desktop computer configurations are over.

Interactive games are only one part of this explosion. Games can be effective instructional tools that entertain while motivating.

Interactive games possess common elements that appear in varying degrees. It is often beneficial for game designers to begin critiquing their work by analyzing the existence of the following elements.

— Entertainment: The differentiating factor between games and simulation is entertainment. Whereas many games tend to simulate reality, it is entertainment that sets gaming apart from simply simulation. It is the entertainment factor that initially attracts students to games, and hopefully continues to motivate one to learn.

- Fantasy: The fantasy element within games can range from a realistic simulation of real life to nonexistent worlds.
- Nonthreatening reality: it is the lack of threat within a game that prompts users to take paths they might not normally pursue. It is much easier to take a financial gamble or risk death in a gaming environment than in real life..
- Objective: All games have an objective or goal to be reached. The objective might be high scoring, solving a puzzle, or reaching a goal within a certain time.
- Rules: The world in which the game exists has its own set of rules. Sometimes the rules are stated, other times the user must find out by playing a number of times what constraints exist. Rules can also change during game play; for example, adding or subtracting constraints based upon the current knowledge or acquired tools.
- Opposition: Some kind of opposition usually exists, in the form of an enemy within the game world, or a race against time, or against oneself in an effort to beat a previous score, or a combination of several of these.
- Hazards: Hazards challenge the game player. Much like rules, the student must learn what the challenges are to the game each time he plays.
- Outcomes: If an objective is met or not, some outcome occurs, such as a high score, saving the planet, or moving onto the next level. The most important outcome in games that train is learning.

Computer-based games for instruction gained wide popularity in schools for their ability to motivate. The goal of instructional games is of course to teach, but many teachers found computer games a powerful motivator for initiating the learning process. The same holds true for interactive computer games within the corporate environment. Focus on the goal of the game is also an important factor. When games were introduced in classroom situations, some students were more focused because they had an alternative learning mechanism to the instructor. Several secondary factors can also be gleaned from gaming within computer-based instruction, such as rules of right and wrong, the existence of chance in the world, and increased comfort with the computer.

Games should not be used simply because they are games. The goal is to maintain the student's interest while increasing his skills and knowledge. Games that are too easy will be dismissed quickly. Since learning occurs with repetition, a trainer wants a student to be motivated to come back to the game often. Game scenarios and rules must also be introduced properly in order to hold the student's attention and understanding. A game should also loosely match the tone of the rest of the training program.

Whereas a game is a unique area to introduce humor and entertainment, the game should not jolt the student. The outcome when a student loses a game should be treated with more importance than when winning. Demoralizing results can lead to humiliation and lack of motivation. With all Web-delivered information, reducing latency is critical. Motivation can decrease quickly if a student is waiting for a game to react or for more information to download. Quick response from the game is crucial. With the volatile nature of the Web, however, some of this will certainly occur.

Dynamic characteristics of gaming software coupled with the ubiquitous connectivity of the Internet make

Web-based instructional games uniquely positioned to enhance computer based training:

- Asynchronous learning opportunities: Geographically dispersed student populations do not have to wait for a training class because of the distant, on-demand nature of Web training and games in particular.
- Process data gathering: Administrative databases running behind the scenes can quickly collect data on how students react to games and their success in order to identify learning patterns. Games on the Web allow ubiquitous and efficient data collection, analysis, and reporting.
- Real-time interaction across a geographically dispersed population: Multiplayer games have the added benefit of actually playing another person instead of simply a machine.
- Dynamic/ changing scenario characteristics: The scenario of a game can also evolve over time to simulate real occurrences such as the stock market, species extinction, or population growth.

3

Interactive Distance Learning Over the Internet

A front-end analysis was performed to ensure the course would meet training objectives that are validated against real job requirements. The approach was eclectic, based on the experiences of the team in doing FEA. Initial contacts with domain experts (DEs) was by phone. Requests for documents, and clarifications over the phone, gave the team the first overview of the training requirements, target population description, and course objectives.

Course materials for MDMP- training were gathered and evaluated. This evaluation guided the selection of instructional strategies, the media selection, and the advanced technology selection. The materials were considered up-to-date and suitable to create the interactive courseware for this project. New measurable objectives were created for the course based on the materials and discussions with the DEs.

The team traveled to Fort Knox and observed an ongoing class. This allowed the team to:

— observe the communication between the seven functional positions that the small groups (SG) of students role play;

- broaden our understanding of the tasks of the seven positions;
- observe students creating overlays/MDMP products;
- observe how the small group instructor (SGI) prompted and advised students;
- observe the Commander's briefing;
- gain a further understanding of the Armor School's expectations for the courseware;
- observe the creation of maps;
- observe the SGI prompting and advising students;
- observe the commander's briefing/presentations of each position and
- meet with domain experts (DEs).

The team met with a contractor building courseware that is prerequisite to the MDMP course. The team:

- delineated responsibilities,
- reviewed flowchart;
- discussed standards and level of interactivity; viewed a demonstration of a small sample of the course; and
- discussed standards and level of interactivity and fidelity.

The team met with DEs to gather information. They:

- met with representatives of four of the seven positions the SG represents when doing the MDMP;
- discussed objectives previously defined with DEs and the Government PM;
- built a list of information students must reference to support the learning tasks;
- delivered a form to assist DEs to collect data for the courseware: and
- completed the information collection forms.

The meetings with the Army POCs and DEs were essential to determine the courseware design and development. The information helped to:

- create a user environment that simulates the work experience, allowing users to interact to solve a problem;
- develop a graphical interface to allow students to create and edit overlays/MDMP products efficiently,
- develop hints and feedback, possibly some intelligence to emulate the instructor;
- provide a technique to allow the seven staff positions to "look up" information; and
- develop ideas for how to make creating maps more efficient.

The Armor Officer Advanced Course is a 20 week course composed of large group instruction, small group instruction, the JANUS command-level simulator exercises, SIMNET unit-level simulator exercises, and field exercises. Initially, the students attend large group instruction together. Then, the students disperse into groups of 15 for the small group portion; a small group instructor (SGI) is assigned to each group.

The MDMP planning exercise reinforces the doctrine, planning, and decision making knowledge/skills. The JANUS simulator is run at the battalion level, with all students divided into command and support functions. The SIMNET simulator is run at the company level, with all students manning specific tank operation positions. These exercises are planned and executed against an OPFOR composed of the instructor group. Field exercises are restricted to terrain appreciation and leader's reconnaissance of the battlefield.

In the current training, the SGI presents the small group with a situation and commander's guidance. The small group is required to exercise the decision making process and analysis tools detailed in the text, and produce intermediate "products" used as input to the next phase of the process.

The final product is a recommended *Course Of Action* (COA) plan, which is briefed to the commander. The Army has traditionally viewed military decision making as both science and art. Many aspects of combat operations, such as movement rates, fuel consumption, and weapon effects are quantifiable. Therefore, the Army considers them to be part of the "science" of war. However, the Army cannot quantify other aspects - the impact of leadership, the complexity of modern operations, and uncertainty regarding enemy intentions/ actions/reactions.

Military Decision Making Process is a systematic approach to decision making, which fosters effective analysis by enhancing application of professional knowledge, logic, and judgment, and consists of six steps:

- Recognize and define problems.
- Gather facts and make assumptions to determine the scope of and the solution to problems.
- Develop possible solutions.
- Analyze each solution.
- Compare the outcome of each solution.
- Select the best solution available.

At the highest level, the actions done in the small group relate to:

- Gathering facts
- Making assumptions
- Analyzing higher mission and intent ; and
- Receiving commander's guidance.

The architecture for the application of technology to this training requirement will involve two major efforts:

1. the implementation of computer-based training activities to provide mission guidance, provide detail data for analysis, and to capture small group intermediate and final products; and
2. the implementation of distance learning technology to link the SGIs with the small groups during and after the construction of the intermediate and final products.

Overlaying the automated instruction and DL technologies to the current course provides an interactive course that covers the same objectives as the current stand-up instruction course. The automated instruction functions provide situation details required for each phase of training action. The small group functions are still completed in small groups.

The Distance Learning functions provide the organization and communication methods for the small groups to get help during the small group actions and to receive feedback on the small group products. Gates are closed until the student products are reviewed by the SGI. The SGI grades the products and opens the gate before the group moves to the next MDMP phase. The MDMP includes Mission analysis; Course of Action (COA) development; COA analysis and comparison, and decision and execution. The architecture was implemented as four major phases:

Phase one

Task description. Derive the essential tasks the unit must perform to accomplish the mission.

Input. Commanders guidance.

Methods. Follow the eleven step process for Mission analysis.

Approach. Using the automated instruction lessons, derive the necessary data to drive the small group interaction in the development of the MCOO, the SITTEMP, and the Restated mission products.

Deliverables. The MCOO, the SITTEMP and the Restated mission products in a format for the SGI to access via distance learning technologies.

Phase two, COA development

Task description. Develop multiple COA's that would accomplish the mission assigned by the Commander.

Input. Planning Guidance and Phase One products.

Methods. Follow the six step process answering the what/ when /where /why/how of a possible plan open to the commander that would accomplish the mission assigned.

Approach. Using the automated instruction lessons, derive the necessary data to drive the small group interaction in the development of the COA plans.

Deliverables. Several significantly different COA products in a format for the SGI to access via distance learning technologies.

Phase three, COA analysis

Task description. Utilize appropriate analysis methods to identify the COA with the greatest probability of success.

Input. Multiple COAs from phase two.

Methods. Utilize the appropriate analysis methods, such as feasibility checks, war gaming, risk assessment, and comparison of war game results, to identify the best COA. Note that several different analysis techniques can be applied based on the situation.

Approach. Using the automated instruction lessons, derive the necessary data to drive the small group interaction in the development of the COA plans.

Deliverables. The brief for the Commander on the selected COA.

Phase four, execute

Task description. Review the COA with the SGI to determine the probable outcome of the recommended COA.

Input. Recommended COA from phase three.

Methods. The group will provide the SGI with a written analysis of the probable outcome of the recommended COA. The SGI will review, analyze, and comment on the recommended COA, and the small group's analysis of the recommended COA, in a small group session. Alternately, the SGI can interact with the small group in a conference call.

Approach. SGI and small group interaction on the recommended COA.

Deliverables. Analysis of the recommended COA's probable outcome.

The Fort Knox Campus is the primary operational environment. The campus environment is the local area network, the available networked computer systems, and the client and server software.

Distribution via the world wide web, WWW, is the secondary operational environment. This will be used to service Reserve and Active Duty forces for refresher and preparatory training. From a standard SVGA PC connected to the ATM LAN at Ft. Knox, the student will download the Mission Analysis TOOLBOOK automated instruction activity which will be executed locally. Because the courseware is much more than page turner courseware, the courseware was deemed too large and therefore slow to do completely over the Internet, hence the hybrid solution.

The TOOLBOOK activity will provide a simulated environment for: the request for information by the small group; the feedback of the information; and the control of simulated time to accomplish the discovery of the information requested. A team of four AOAC students will use Microsoft Word to provide a written text and graphic to communicate the intermediate products in a format for the SGI to review. The Word documents will be filed to a server, organized by an email notes file package. The instructor will comment on the Word document using the Word annotating features, which allows comments to be made without including the comments into the main document. The instructor will annotate the drawings; these comments are included in the original drawing.

Using a modified version of TIEPAINT from TIE, Training Icon Environment, Global demonstrated the abilities needed to display and edit the "layered" map scheme needed for the Army TDMP project. The modified product, called MAPEDIT, consists of the original TIEPAINT and 2 added pop-up menus, labeled ViewLayers and EditLayers. The ViewLayer menu has eight items, numbered 1 through 8. A student can check any or all of these items, and the corresponding layer(s) will be displayed.

The EditLayer menu item allows a student to select which layer he wants to currently edit. The editor is basically the standard TIEPAINT "vector" editor. Each vector object has an extra "tag" on it, which indicates which layer it belongs to. When items are displayed, only those items which are part of the active layer(s) are displayed. The scheme is simple, and works very nicely. MAPEDIT is a 32 bit Windows application developed using Microsoft Visual C/C++ version 4.0. The source code consists of various c, h, dlg, ico, .bmp, all of which comprise the actual "project" file. *There is* also a "help" file, which uses Microsoft WordView to display hypertext style help.

Student and instructor workstations exchange data via a shared directory on a network server. We do not want to hard code the path to the shared directory. Instead, the directory path is stored in an INI file on each workstation: $WINDOWS\TDMP.INI. The section is *"Server" and* the entry is "Root."

In keeping with Windows convention, the INI file is stored in the Windows directory of each computer. All programs that reference this file should use the GetWindowsDirectory function to get the name of the Windows directory rather than hard coding the usual path. The group file *serves as* the main repository of information about the group's progress through the TDMP lesson. In a production version of the system, group information would be stored in a full-featured relational database with Internet capability. However, the proof of concept version will use a simple Windows initialization file ("INI" file). The INI file contains a section for each step in the TDMP lesson. The group file contains a summary of the group's progress. Large items, such as justification statements, COA sketches, the Sync Matrix, and the DECMAT, are stored in separate files.

One instructor leads a typical class consisting of 64 students broken up into 16 groups of 4 students each. The primary role of the instructor is to facilitate the tactical decision making process as students try to formulate effective course of actions (COAs). During the decision making process, students are assigned one or two functional roles in which to analyze the information. A total of seven roles are divided among the four students in each group. Students must submit two interim products and one final product. The instructors will review, score, and provide feedback to the group for each submitted product.

The independent variables to be manipulated include instruction and on-line help. The dependent variables that will be measured include: 1. achievement and efficiency as scored by instructor ratings of the three submitted COA products and the time it took to reach the COA products, 2. subjective workload, 3. the mental model developed during the tactical decision making process as measured by paired concepts, 4. the rate and quality of communications across teams and, 5. affective preferences. Covariates will include individual differences in subject matter knowledge as scored on a pretest and prior field experience.

Two interim products and one final product will be scored and used as a measure of student achievement. The instructors for the course will grade these products. Each instructor will be responsible for scoring half of the products produced by each treatment group. In addition, the products will be submitted to the instructors using codes so that they will be blind as to the source of the product. These methods will be used to prevent bias toward a particular treatment condition. The amount of time the students took to submit each COA will also be recorded automatically by the system. In the traditional classroom treatments, the instructors will log the time of each lesson taught. Any additional help by the instructor to various students outside the classroom will also be logged.

The issue of collaborative learning is relevant for this project as students in both learning environments will be working together in four person teams. In addition to these four team members collaborating together to meet a mission objective, these teams are encouraged to seek advice and information from the other teams formed within the class.

Computer-mediated learning involves many, sometimes radical changes in communication patterns. Rather than numerous verbal and nonverbal cues available in face to face encounters, distance learning environments constrain contact to primarily text. Typically, user acceptance of distance technology requires changes in how one thinks, composes materials, and communicates. Researchers point out that often new learners appear to experience some form of "culture shock" which dissipates with additional practice and experience with the system.

In an attempt to quantify these reactions to the medium of communication, learner discussions will be audiotaped and transcribed verbatim, From these transcripts, independent raters will classify each recorded learner interaction into one of four categories suggested by Dalton in the measurement of computer-supported collaborative work: management, social, task, or content.

Learner attitudes toward distance learning can be grouped into four categories: 1. Attitude toward the technology, 2. attitude toward distance education teaching methods, 3. attitude toward student and teacher interaction, and 4. attitude toward being a remote student. Of the research reviewed, only one affective survey has been found that adequately samples learners on all four of these dimensions.

In pace with the technical development in the telecommunication field, the possibilities to transfer large amounts of written information have increased. The use of fax machines is an example of an application replacing letterwriting and telephoning. Fax communication has been used in different work environments for many years, but in a home environment is a relatively new application, especially for persons with functional impairments. From literature surveys of several databases within the area ofcomrnunication/integration and telecommunication it appeared that the use of fax machines for transmission of graphic symbols and pictures is a new application for persons with mental retardation. Previous studies have shown that 'still picture telephones' can be used to stimulate the ability to communicate in people with severe and moderate mental retardation. This application for transferring messages is a visual telecornmunication system for connection to the ordinary analogue telephone network. A still picture telephone consists of a camera and a monitor.

The user can transmit and receive 'frozen' pictures of himself, photographs, other pictures, or graphic symbols. Transmission of Pictures via the telephone network takes approximately six seconds. Still picture telephones were also used for persons with speech impairments eg, aphasia, and to support the memory function of persons with traumatic brain injuries. The results of the above studies revealed that the use of visual and auditory impressions simultaneously facilitated and supported COMITILInication in the participants and their interests in communication increased. Since the 1980s more and more people with mental retardation have moved from institutions to group homes, due to political decisions and the changed ideology of social care. While the abolition of the big institutions is a result of a desire to increase the quality of life of persons with mental retardation, it is probably also a question of economy.

Many adults with mental retardation today have difficulties connected to their previous lives at institutions. Some difficulties can be referred to the socialization process and problems to adapt to life outside the institution, ie, that these people have not learnt the rules of an approved social behaviour and consequently experience difficulties in interacting with the environment. The long-term experiences of living in institutions are reflected in their ways of handling their life situations. Quality of life often relates to integration and non-nalization and is influenced by interaction with the environment. The concept of quality of life is thus a measurement of how this interaction functions.

Naess and Nordenfelt emphasize that quality of life is primarily related to satisfaction of basic human needs and includes both objective and subjective factors. A vital basic need is communication. It seems to be of great importance for increasing the quality of life of persons with functional impairments that they are given possibilities to reach independence and to make choices, ie, to be able to influence their lives. Kishi, Teelucksingh, Zollers, Park-Lee and Meyer (1989) stated that individuals with mental retardation make less choices than other persons in society due to difficulties in making choices, few options given by parents and staff, and difficulties in communication. However, March emphasized that photographs and pictures may help this population make choices and improve communication. He reported that the use of pictures limited the need for spoken language and facilitated communication.

A significant factor stressed regarding quality of life is the possibility to interact with the environment. Quality of life is also a question of independence and social interaction, ie, participation in society. It is reasonable to believe that these aspects can be supported by new technology eg, fax communication. As about 70% of all persons with mental retardation have additional disabilities, mainly speech and communication disorders, there is a need for communi-cation aids for this population. The lack of a functioning spoken language and inability to communicate adequately in everyday situations are apparent, and many different communication modes are used at the same time, ie, total communication.

Augmentative and ·alternative communication (AAC) means an alternative to spoken language and an augmentation and complement to speech. Alternative communication is often based on graphic symbols ie, pictures and photographs, and is used in combination with technical aids. Communication aids can be used as a tool to compensate and reduce the consequences of functional impain-nents. Persons who have never been able to communicate via an ordinary telephone have, with new technology, managed to send messages to friends, parents and staff via visual telecommunication systems using different kinds of symbols such as photos, pictures, and graphic symbol systems. For persons in need of graphic communication, Pictogram, Ideogram, Communication (PIC) and Picture Communication are, together with photos and pictures, the most commonly used graphic symbol systems for persons with mental retardation.

PIC is a Canadian graphic communication system used in daily communication by persons with mental retardation and with a poorly developed or no spoken language. This system is an augmentative and alternative way of communication, consisting of about 750 black and white concrete symbols. Symbols from different systems can be mixed in order to satisfy the special needs and cognitive level of each individual. The choice of an alternative communication mode depends on:

- present speech and communication skills;
- willingness.and motivation to communicate;
- ability to identify and classify pictures/objects;
- ability to coordinate and indicate objects;
- sensory and motor functions;
- level of cognitive development; and
- social and physical environment.

Three main aspects of communication are of significance; communicative form, communicative content and communicative use. These components form the basis of the communicative competence, ie, the competence to function adequately in daily life, and an integration of these components is necessary.

The aim of the present study was to investigate if the use of fax communication could facilitate and support communication in persons with moderate mental retardation, and if fax communication could increase the possibilities to stimulate social contacts, thus enhancing the quality of life for the individuals involved. An additional aim was to survey if fax machines could be considered a communication aid for persons with mental retardation. The study was based on previous research in the area of telecommunication for people with mental retardation. Five persons, one woman and four men between 30- and 35-years-old, participated in the study. The participants were selected by the staff at four day centres in cooperation with the project Fax Communication—A New Way for Distance Communication for People with Mental Retardation 137 leader on specific criteria. They had no verbal language, communicated with PIC symbols and were assessed to be in great need for support in their daily communication. Their opportunities to communicate at distance, eg, by telephone, with parents and friends were limited.

The participants were assessed by medical staff, parents, staff at the day centres and group homes to be moderately mentally retarded and in need of support to communicate. Moderate mental retardation corresponds to an IQ of I I to 45, which means the B-level according to Kyl&n's theory of intellectual development. This theory, based on Piaget and mainly used in Scandinavia, is a functional assessment of mental retardation. Additional disabilities, primarily speech and communication disorders, are common in this population. The project ran for 12 months and altogether 653 fax messages were registered during this period.

The terms fax and fax messages are in this article used synonymously. Fax is used both for the fax machine and for sending fax messages. Two fax messages per participant were sent each week. All faxes were registered in a protocol by the person assisting the project participant when transmitting. The protocols included records of initiator, communication partner, conversation topics and the participant's attitude to sending and receiving fax messages. The data collection included background description based on questionnaires, fax protocols, diary notes and interviews and gives a generic view of the participants and reveals possibilities and difficulties in fax communication for persons with moderate mental retardation. At the project start, staff from the day centres in collaboration with parents and staff from the group homes completed a questionnaire covering the background for each of the participants. This was completed with details from medical journals after approval of parents/relatives.

The personal descriptions give a view of the participants' whole life situations, functional impairments and communicative abilities. The staff involved in the project were the ordinary staff working at the day centres. They made diary notes each week in order to get a view of 'how the faxing was working' and to explain prospective interruptions in use. Interviews with the staff were made continuously in order to get an assembled picture of the process. At the end of the project interviews were made with staff at the group homes, day centres and with the parent participating. The interview questions were semi- structured and covered the equipment (technology and ergonomics), placing of the equipment (physical environment), attitudes of persons in the local environment towards the use of the fax (social and relational aspects), influence on their daily living (social and personal aspects), and communication and future possibilities of using the fax (socio-relational and personal aspects). The fax machines used in the project were of the type copyfax. They were placed at four day centres, four group homes and at one of the parent's home. An ordinary telephone was used to make the calls, but automatic diallers and loudspeaking telephones were connected.

All participants used the 'Giant button', which is a telephone aid with large buttons and photos of the communication partners and used for automatic dialling. The results showed that the copyfax was easy to handle for the participants. Hjelmquist and Winroth Hallqvist studied reading service for visually impaired persons and reported that the copyfax machine was preferable also for persons with visual impairments, due to its simplicity to use with few operating movements to be carried out - similar to an ordinary copying machine.

The personal descriptions were based on information from the questionnaires completed by parents, staff at day centres, group homes and medical journals. Their purpose was to give a general view of the project participants, their daily lives and local environments. One woman and four men, between 30 to 35 years of age, with moderate mental retardation participated in the study. Four of them had lived most of their lives in institutions, one had grown up with his parents.

Today all of them live in group homes and attend day centres. They went to the special school for mentally retarded children. The questionnaires revealed that the participants had a limited social network. The only person who had continuous contact with her family was the woman, Lotta, who had contact with her mother. Lotta's mother was the only parent participating in the project. Bronfenbrenner used a developmental ecological approach to describe the significance of the social network, and based on this definition, limitations regarding the network for the persons participating in this project appeared, Bronfenbrenner stressed that the systerns of importance were: the inicrosysteni, the inesosystern, the exosystern and tile nlacrosystern. These systems together lbrin an entirely, necessary for an overall view of the individual. The importance of the social network is brought up in the final discussion.

The frequency of additional impain-nents is often high in persons with mental retardation and this negatively affects their possibilities for interaction and for active participation in society. The five project participants had several additional impairments, but impaired vision, speech and communication disorders dominated.

The five participants were assessed to be in great need of cornmunication support, but a fundamental condition for persons with mental retardation to benefit frorn communication aids like fax is that it corresponds to a real need. This need was not obvious from the start, as the project participants had no prior experience of faxes. On the other hand, can such a need arise if a person finds out that he can benefit frorn an aid? If there is no real need, the application becornes constructed and artificial.

All participants were interested in making and sending fax messages and they had a positive attitude from the start. A contributory reason for this was probably that the staff were positive and regarded the participation as a challenge. On the individual level it appeared that the project participants were positive to use the fax machines. They got much attention during the project time both from staff and peers and this had positive effects on thern. The personal attention resulted in a higher status in the group. Concerning some of the participants the staff commented: 'Both staff and the mentally retarded persons around them are treating them differently today, with more respect, and this has affected their self-esteem.' The staff knew the participants well, and it is reasonable to assume that their judgements, that the participants' communication had been improved by using fax, were correct.

The personal attention was positive as the project participants got more space in the daily activity as far as time is concerned. They received individual training and possibilities to establish deeper contacts with staff, with whom they had not been in touch earlier, and with other project participants. Factors affecting the use of the fax were: a real need for communication support, that the personal attention increased the interest in communication with other persons, and that their status increased as the new competence was highlighted.

The project participants used PIC symbols in order to send fax messages and for some this was experienced as 'hard work'. They also used other modes of communication, eg, stamps with PIC symbols were used when making their fax messages. It was timeand work consuming for the staff as well as for the participants to make up the messages.

All participants were able to handle the fax machine by themselves. The staff and the parent involved agreed that the equipment was easy to handle because of the fact that there were few operations to learn. The equipment worked well functionally and operationally. One factor affecting the use of fax could be disability. Lotta, for example, had a severe motor disability, but this did not affect the frequency of faxes sent. No connection between the frequency and disability was found, but it is reasonable to believe that this was more a question of will and motivation.

Many persons growing up in institutions have had poor support in communication. One factor affecting the quality of life is the ability to communicate. The ability to communicate is emphasized as being one of the most important components of human development. On the basis of this, it is reasonable to presume that a person who gets the possibility to communicate also develops in other respects. Several different factors affect the interaction. Partly it is a question of type, and degree, of functional impain-nent and the limitations it involves, partly it is a question of context in which the interaction takes place. The context is of significance, but personal qualities such as will and motivation to communicate also influence the interaction, Of great importance for adults with mental retardation is their earlier experiences of interaction. A person who time after time tries to make herself understood, but fails, experiences difficulties in showing motivation to communicate. A sensitive environment is therefore necessary.

Sometimes the difficulty to communicate can be in the situation itself—in positioning, or in the relationship - to what extent the people interacting are able to adapt to one another. Communication is a matter of giving and taking, and involves sharing experiences, actions and feelings. The adaptation between parents and children is strongly stressed by researchers in early infancy. Both parties adapt to each other and the child learns to take turns in communication. Another difficulty can be that the ability to communicate has not been developed and they appear to be passive and uninterested in the environment. Some have a self-destructive behaviour, others have stereotypes, although in some cases these behaviours can be interpreted as being communication. Both the parent and staff stressed that the participants had developed their communicative skills during the course of the project. The staff based this presumption on the fact that the participants themselves choose to whom to send faxes, and what the fax message should be about, ie, the topics for communication.

The rapid technical development, however, gives reason to believe that more and more institutions and private users will have access to fax in the future. The project participants became, according to the staff, more interested in communicating and the topics became more relevant. The content of the messages was to a large extent about every day things, but they later on picked out PIC stamps relating to events they had actually experienced. The content revealed that the participants became aware of the meaning of sending faxes. They chose pictures, decided to whom they should send messages and what they wanted to say. Favourite topics were past and future activities, food and parties. One of the staff members gave an explanation of the increasing interest in communicating, stating: 'They were given a tool - the fax - and they used it.'

The participants' contacts with parents, siblings and relatives had become intermittent and their social network had become limited over the years. Kurt, who had lived with his parents, had a natural relationship to his relatives. Krister and Bertil had no, or limited, contact with their parents. Lotta, who earlier had been in contact with her mother once a week, has since the start of the project been in daily contact with her mother. That this has been of value to both Lotta and her mother is apparent from the diary notes and fqy records, eg (the staff expressed regarding the mother) 'her contact with Lotta has become deeper and more natural'. The mother confirrns that this is the case and regards the fax as a useful aid in order to maintain a reasonably 'normal' adult-relationship.

According to Bronfenbrenner's system of ecological development, the social network can be divided into systems. The primary network, which is called the *microsystem,* concerns the family, home, day centre and activitites taking place close to the individual. The *mesosystem is* the following level in the system and consists of various microsystems linked together into a larger unit. It can be a matter of relations between group homes, day centres and the staff connected to the activities. In this project contacts have been established between the four day centres, the four group homes and the staff involved in the project. This has implied an attempt to widen the primary network into a larger one.

Many persons with mental retardation need a larger network than they have today. For those living in group homes and attending day centres it is often difficult to make new friends within as well as outside the sphere of care. In order to increase the social network for people with mental retardation, there is a need for staff ready to be of assistance. The other two systems are the *exosystem* and the *macrosystem* and these systems are more difficult to influence for the individual. The further out from the microsystem one gets, the more sparse the network becomes. On that level it is more difficult to influence the situation for the individual.

The project participants have made new friends and will in the future be able to maintain contact with other people who have access to a fax. The more people who have access to fax, the more possibilities for communication there are. During the project the staff at the group homes and at the day centres had more contact with each other than they normally would and opinions differed regarding the benefit of that. Some emphasized that getting to know each other better made it easier to get in contact if there was something that needed to be discussed. The parent taking part in the project had more frequent contacts than usual with Lotta's group home as well as with the day centre and it is reasonable to presume that, despite all, there was a better understanding of the third party's perspective.

There can be difficulties in having good relations between day centres and group homes. This does not necessary mean fundamental disagreements, but there can be misunderstandings regarding details, eg, somebody has forgotten to bring his/her spectacles, rucksack or something else that the staff at the day centre feel is important. There are differences between the activities at the group home and the day centre, which explains the different view on things. Day centre staff are focusing on activities while the staff at the group homes are primarily working with care. The staff's attitudes to different activities are of great importance. Sometimes it can be a problem to find enough time for an activity. In all of the diary notes and interviews the problem of lack of time has been put forward. It is difficult for the staff to know to which activities to give priority; indeed several of them have stated that they are in doubt whether it is correct to spend so much time on one particular individual and put other persons to the side. This, among other things, caused a conflict at Bertil's day centre.

Many people with mental retardation are in need of continuity of staff and react negatively when stand-in staff are working. Changing and shortage of staff are significant for the results, but the diary notes also showed shortage of time and statements such as 'this week we have not used the fax very much because of...'. There are naturally obvious reasons for not sending faxes, but nevertheless it seems as if the possibilities for the participants to influence their own situation are limited. The five participants have more or less used the fax machines on the staff's terms, and have not, to any great extent, had the possibility to direct the use. A major limitation of this study is the small number of participants. The study continued for about one year with quite a large number of faxes being sent. The popu-lation involved, and the costs of technical equipment, also influenced the nurnber of participants. However, it is my desire that the cases in this study may contribute to new knowledge and stimulate further research in the area of new technology and mental retardation.

The last decade has seen a profound change in thinking in Australia about the processes and outcomes of university education. Together with a reconceptualization of the educational process which puts the learner at the centre of, and the focus, of the interaction, conceptions of learning now have broadened from the traditional one of teacher as transmitter of information to teacher as facilitator of student learning. As with the Enterprise in Higher Education in the UK, this movement has been accompanied by a focus on generic outcomes, such as communication, team work and critical thinking, which are increasingly being seen, particularly by employers, to be important and desirable.

We explore the extent to which a high-tech environment supports and facilitates the acquisition of these attributes but it is interesting to note that this movement predates, and is independent of, the current move to incorporate information technology into university teaching. Our title requires that 'effective teaching and teaming' should be defined. Effective teaching is that which leads to engaged and intelligent learning; effective learning involves a desire on the part of the learner to grapple with and understand material in order to be able to carry out the higher cognitive functions like application, extrapolation, integration or problem-solving. In terms of current literature 'effective learning' requires or entices the learner to take a deep approach rather than a surface approach to the curriculum. What outcomes could be expected of a learner who takes a deep approach to teaming in the subject? The following list represents a consensus among workers and researchers of the desirable and beneficial outcomes of such an approach.

Technological advancements in education have received much attention in the last few years. Researchers have explored areas such as intelligent tutoring systems, expert systems, hypertext and multimedia as a possible substitute for a human teacher. It appears that the much attended user modelling aspect of this research has failed to address the diversity and richness of the educational environment- even in terms of their basic properties.

The range of possibilities and diverse subject disciplines are indicative of the size of the problem, let alone identifying and catering for individual differences. Traditional intelligent tutoring system (ITS) designers have attempted to provide tutoring facilities that try to satisfy all of the student, teacher, curriculum and institutional needs. However, this has proved to be an immense task. An increased understanding of this immensity has brought about increasing recognition of two concepts. The first relates to the general acceptance that knowledge has a contextual component and that the context provides a principled way to cluster, partition and organize knowledge.

The second relates to the acceptance of the role of a student's common sense and general problem-solving abilities in the learning process - some researchers arguing that human tutors virtually never provide he sort of 1 explicit diagnosis of student misconceptions that is sought to be provided in a traditional ITS. It is also important to examine the suitability of diverse technologies in an educational context. It would be useful to identify the differences between computers and other educational technologies.

In a learning context, a video clip accompanied by audio on a multimedia computer is no different from seeing it on a video player, unless the computer offers some opportunity for interaction. The value of such interaction, apart from the morale boosting confirmation of a correct action, lies in the province *of learning by mistakes.* This demonstrates that the *known-how* type of knowledge is more suitable to computer-based learning. With the increasing demand for a broad based appreciation of multiple disciplines, there is an increasing pressure on academics to ensure the transfer of adequate skills to all students-some of whom may be less motivated than others. While staff resources for lecturing are relatively less affected by this increased demand, the tutorial aspect of teaching requires a growth that cannot be met due to insufficient funding.

Increased reliance is placed on self-study, which poses no great problems for well-motivated students; however, it is the remaining students for whom an adequate level of knowledge transfer has to be ensured either directly through the teacher as an instructor or indirectly through the teacher as a facilitator for adequate knowledge construction. The resource intensive tutorials generally deal with the operational *(know-how)* aspect of knowledge and are suitable for software tutors as noted above.

A consortium of six British universities (known as the Byzantium Project) obtained substantial funding from the UK's Teaching and Learning Technology Programme (TLTP) in order to develop tutoring software for introductory accounting. The funding was obtained on the strengths of DOS-based prototype software to Support the teaching and learning of Marginal Costing. The prototype was developed in order to demonstrate the utility of applied artificial intelligence to student learning in introductory numeric disciplines and to date has been used by more than 3,000 students. Unlike traditional intelligent tutoring systems, the Byzantium project has a modest aim - that of producing intelligent tutoring tools (ITTs) that extend a lecturer's scope. This is achieved by horizontally partitioning some of the teaching activities eg, supervising the development of operational skills, and assigning them to a computer tutor. It should be recognized that computers, though quite powerful, are only one of the educational technologies that can be applied in a teaming environment.

This recognition in itself causes a shift away from comprehensive ITSs to ITTs that can be mixed and matched with other educational technologies and human teachers in various configurations in order to create a computer integrated learning environment (CILE) to suit classroom-based, open and distance learning strategies.

One approach to computer integration within a learning environment is reflected in the Byzantium model of CILE. The aims of the approach are:

- — to use computers and humans for what they are *(currently)* good at;
- — to employ useful software tools within the overall learning environment consisting of human teachers and educational technologies;
- — to add a level of applied artificial intelligence to the software tools in order to provide a degree of support to students thereby enabling them to work by themselves;

- — to let intelligent tutoring evolve in a bottom-up fashion rather than be designed top-down;
- — to understand the economics of the learning environments and be concerned with assessment and course management as they consume substantial human resource - the system should provide economies of staff time in all areas of the teaching cycle, e.g. exposition, example setting and grading work.
- — to appreciate the economics of software production and recognize that tutoring software is a joint cognitive system involving a student, tutoring software and a human teacher whose involvement may be greater or lesser depending on the capabilities of the software and the manner of its integration into the curriculum. In such joint cognitive systems, it is more economic at times to increase a student's understanding of the tutoring software or let a human teacher handle certain aspects of the teaching than expend huge effort and expense in trying to design a comprehensive ITS that attempts to comprehend predispositions and mental processes of students with different personalities and backgrounds;
- — to acknowledge that various educational technologies have their own strengths and that a learning environment benefits synergistically from an appropriate use of multiple resources and therefore the usefulness of any resource can only be studied in the context of systems employing it.

It should be recognized that a usable, true and substantial ITS is, intrinsically, a highly complex system. Achieving this level of complexity by designing it top-down is almost an impossible task, that is complicated further by the continuously evolving technology. It would, therefore, be useful to view the highly complex system as being made up of smaller entities which are networked- the connectivity producing the necessary flexibility and synergy. When this smaller entity has a degree of intelligence, it is an intelligent system of a lower order. To distinguish it from the conventional understanding of an ITS, it is called an intelligent tutoring tool (ITT). It is hoped that when sufficient ITTs are ready, a second level of integrative tools will become possible. This integration can occur in two directions: vertical and horizontal. *Vertical integration* in a Ranking ITT allows holding and comparing results of different instances of an ITT, for example, comparing four different investment proposals in the presence of a ranking factor like the investor's attitude to risk. *Horizontal integration* in a Linking ITT allows use of multiple tools to solve a given problem -for example, a Marginal Costing ITT providing contribution figures for maximizing profit in a Linear Programming ITT. Thus, while a simple Linking ITT is a network of basic ITTs, it can be extended along the dimension of aggregation granularity to include other Ranking or Linking ITTs.

The advantage of this approach is that the necessity of interpreting complex interactions and the construction of complex feedback messages is eliminated. A student who has failed to grasp any of the intermediate steps drops to an appropriate granularity level where the simple feedback messages are adequate. The emergence of a higher degree of intelligence through connectivity is demonstrated by combining the ITTs with a teaching support tool (TST) like the *Marker* software which enables testing of a student's interpretation for an examination-type narrative question and allows the system to discriminate between correct solution, incorrect interpretation but correct method, and incorrect solution.

An individual ITT is thus envisaged as an autonomous entity possessing rudimentary intelligence and then connected in a decentralized network enabling the emergence of a more sophisticated tutoring system. Even if this vision fails to materialize, the individual ITTs have their own utility and the total effort is not wasted. In order to appreciate better the strengths of an ITT, some aspects of their design are discussed next.

An ITT is designed around a software engine which stores and processes knowledge rules. Its main features are:

a. a *knowledge base* containing the conceptual rules and processing information. It consists of two sections that together embed common didactic knowledge and domain didactic knowledge;

b. a *student model* which records a student's progress towards a complete solution. It contains four basic items:

   - values entered by a student;
   - value status; for example, differentiating a zero value because of a blank variable, calculated zero or data not processed due to an infinity condition;
   - status of the edit fields filled in by students, such as blank or intrinsically dependent (to begin with) and independent or dependent variable when filled;
   - user preferences of generative aspects of the interface; for example, in a Capital Investment Appraisal (CIA) ITT, students can choose whether the discount factors are given by the system, filled by using a 'Table' or calculated using a formula;

c. an *expert model* which links to the knowledge rules. This derives correct outcomes and records how they are derived. In the case of a narrative question, the local expert model is based on a student's interpretation of data while the remote expert model in the *Marker* software provides the correct interpretation - their combination enabling

Marker to assign a partial score for an answer based on a correct method but an incorrect interpretation of given data, demonstrating emergence of a higher degree of overall intelligence from the connection of the rudimentary intelligence of an ITT to the *Marker* Teaching Support Tool (TST);

b. a *tutoring module* which links students to the various parts of the engine through its user interface and gives advice based on the work done so far. It allows a student to adopt a different route to the solution than the expert model;

c. a *user interface module* which provides interaction between an end-user and various parts of an ITT;

f. a *level selector* which determines the functionality that is made available to a user through the interface. The levels are:

  — the *student level* which allows the use *of* the ITTs for learning without being able to create examples for others to use;

  — the *lecturer level* that enables instructors to create examples or templates for use by the students and to save model answers used by the *Marker*. Marking of students' assignment work is also possible at this level. An 'auto-solve' option is provided at this level that solves whatever it can as each independent variable is input to enable adjusting of inputs to obtain a desired scenario;

  - an *administrator level* in which the global management of marking schemes and students' data is possible. This functionality was subsequently taken out of individual ITTs and centralized in the *Marker* to enable summarized results over a number of ITTs;

g. set of *enhanced features* which embed functionalities such as:

  - a *random question generator* which randomly picks variables and assigns random values within specified bounds and then derives the solution by applying its knowledge rules. Thus, an ITT need not contain any data bank and all students can get individual questions but a lecturer can create a bank of questions to be used by all the students, if so desired;
  - a *dynamic feedback system* that generates feedback messages dynamically based on the information received from a tutoring module. The software's advice to a student is based on the work already done by that student and what the student should best do next.

In the case of an examination-type question - given in a narrative form and requiring a student to interpret data, identify given values and derive a solution -the lecturer's model answer held on the *Marker* software serves as the overall expert model conveying the correct interpretation and the correct method while the application (local) expert model tests correctness of the method employed by the student.

The combination of remote and local expert models enables the *Marker* to give a partial score for an answer based on a correct method but a wrong interpretation *of* given data. This clearly demonstrates the emergence of a higher degree of overall intelligence from the connection of the rudimentary intelligence of an ITT to the *Marker* software. The implementation of applied artificial intelligence enables an ITT to generate random examples and assist students in solving them.

The Byzantium ITT has two main modes of operation: the interactive mode and the assignment mode. In the *interactive mode,* the software does not let a student enter a wrong value and provides immediate feedback, as found in a student modelling technique known as model tracing - the difference being that a student's outcome is monitored rather than the process (rule) employed. Such dynamic feedback is considered essential for learning as it prevents (at source) any incorrect mental associations being made by a student.

In the *assignment mode* (which is meant for testing) there is no immediate feedback and the software allows any values to be entered. Feedback on their correctness is given after the work is marked. This is static feedback. As Routen observes, 'There are advantages with both forms of student monitoring. Static feedback perhaps is less obtrusive... while dynamic feedback prevents students from making gross errors and getting completely lost.'

Patel describes the variables on the screen as empty containers connected in a network of interrelationships. They represent an instance of their associated concepts. Any value can be entered in any variable, provided the whole network remains consistent. The intermediate variables need not be filled in. This approach allows mental calculations and does not force a rigid path to the solution.

Provided the value being entered is correct, the ITT assumes the intermediate steps to be well within a student's conceptual knowledge boundaries. If the value is incorrect, then the ITT guides the student in a graded manner. This advice is not based upon some hard-coded set of instructions. A student model is applied here to improve student learning. According to the terminology used by Self, corrective, elaborative and evaluative aspects of the student model are used. The advice given by the software to the student is based upon the extent to which that student has been able to solve the problem so far and, in view of that, what that student should best do next.

The corrective behaviour of the software tells the students whenever they make mistakes in calculations. If they make a mistake second time, elaborative behaviour comes into action, which suggests the various relationships by which certain values can be calculated. The suggestion depends o, what the student has done so far. If enough information is not available on the screen to calculate a certain value, the software guides the student to fill in other values before attempting to complete that particular value, The evaluative aspect of the software is featured in the *assignment mode,* which is designed to assess the gain in a student's knowledge. Diagnostic, predictive and strategic aspects of the student model are not considered to any significant degree in the software, the reason being that the learning topic has been 'sliced' into such small modules that they become the most basic units of that topic.

A 'Road to London' paradigm is adopted -which is more concerned with 'what to do next' rather than 'how did I come here'. Coupled with dynamic feedback this paradigm keeps on reinforcing the correct connections throughout the network of interrelationships and eliminates the need for the above aspects.

The interface to the Byzantium ITT includes various features, such as:

— a context-sensitive help link to textual descriptions of topics;

— file and print management; and
— efficiency/learning support tools - which may be either general, such as an on-screen calculator, or application specific, such as the discount factor table in the CIA ITT.

The user-interface is mouse-driven and employs only push-buttons, scrollbars and edit controls - so as to make the interaction as simple and instinctive as possible. A push-button is also activated by a keystroke of the letter highlighted on its label. This allows for mixing the mouse and keyboard events to enhance a user's efficiency and comfort. All data entry is done through an edit control, suitably masked to prevent entry of illegal data.

The interface also reserves a certain area on the screen for interactive feedback, so users do not have to search the whole screen for the information that they require. As students prefer greater use of diagrams and pictures, graphical representation of data is provided wherever possible and the on-screen tutorial text is augmented with illustrations and replicas of screens.

The Byzantium ITT is designed with the consideration of high visibility, logical decomposition and visible dependencies. It does not provide ready solutions and waits for a student to execute an action before providing a hint. The ITT accepts a correct entry, regardless of the state of the student outcomes model, allowing a student to carry out some operations mentally. It forces an intermediate step calculation only in case of an invalid entry - signifying that a student has not fully grasped the chain of relationships. The ITT also provides support for decomposing complexity, that is, a student who is not confident about using a formula can call up a formula interface in the *Capital investment Appraisal* module, which has the formula decomposed into its various constituents.

A student can obtain expert help in filling each of the constituents and can work in stages to derive a result of that formula - in the context of the data to which the formula is to be applied. In the first level of integration, the ITTs are linked to Teaching Support Tools (TSTs) like the *Marker* mainly through the data driven programming paradigm, as each ITT, through its file structure, informs the *Marker* about its fields.

The development of the four diverse ITTs provided necessary information to formulate the methodology to construct a general purpose tutoring tool builder. The builder, and the interactive dialogue with a subject teacher, will produce the ITT for any numeric discipline. The ITT approach can be implemented on the Internet through the creation of intelligent tutoring applets (ITAs). The Internet allows these knowledge entities, in the form of ITAs, to be held and accessed in a structured manner. With the appropriate structuring parameters, the ITAs created by different teachers build up to a large inventory of accessible knowledge that can be utilized by all the teachers in various configurations of single or multiple ITAs to suit more advanced applications.

The students will need to download the general purpose ITA modules only once, as they could be used by any ITA. In order to run each ITA, the students would need to download the appropriate ITA configuration file, created by a teacher and made available on the Internet. The ITAs will enable students to use these tutoring tools interactively using standard web browsers while obtaining the same feedback and guidance as provided by an ITT.

The indexing of the ITAs would require an approach that is concept based where the ITAs are classified according to all the subject domains where they may find an application and may fall in more than one classification due to the overlapping of the concepts in various disciplines. The possibility of linking various ITAs in a configurable teacher designed ITS allows the extension of the ITT concept to more complex applications. However, the methodology could only be firmly established after more prototypes are built and tested on the Internet.

4

Internet in Social Studies Instruction

The Internet is a large collection of networks that are linked together so that millions of users can share their vast resources. The Internet began in 1968 when the United States Department of Defence research network linked seven different university computer science departments in response to a need for military Institutions and universities to share their research. In the 1970s, university networks continued to grow as many organizations began building their private networks. In the 1980s, the National Science Foundation created five supercomputer centres at major universities. This special network is the foundation of the Internet today.

The most significant recent development In digital technology has been the phenomenal growth of the Internet. The Internet is constantly growing as more and more universities, schools, organizations, companies, Institutions and Individuals make available new resources.

The Internet makes these resources available to each and everyone of us, without distinction, through our computer networks. These networks globally interconnect us with each other and to the wealth of information. The history of the Internet has been accidental according to

Rehingold: "Again and again, the most important parts of the Net piggyback on technologies that were created for very different purposes"

Access to the Internet has many different meanings to people. Any commercial or institutional service that has Internet access provides five basic services: sending messages via electronic mail (e-mail), logging into distant places with Telnet, sending and retrieving files by FTP, reading and posting information to Usenet, and browsing for information using Gopher and the World Wide Web. Three promising areas of emerging Internet technology are audio conferencing, video conferencing, and virtual reality. Internet Relay Chat (IRC) lets other users or other Internet computers see what is typed on our screen. However, the latest software like Net Phone are making two-way spoken communication possible over the Internet.

Video conferencing requires a very fast (384 kbps or faster) Internet connection in order to be effective. Softwares like CU-SeeMe allow computers equipped with video cameras to communicate with each other using live video audio. Each image appears in a small window on your computer. Visual Reality software gives the impression of three-dimensional interaction. A few examples include the computer -software game Doom and TurboGopan UR.

There are three tables provided. The first one, for the sake of beginners, is a Primer of the Internet Glossary. It Is followed by the Characteristics of Learning from the Internet, and the Uses of the Internet In Social Studies Instruction. The Internet sounds like both friend and foe. We need to be aware of the problems, concerns and dangers of the use of the Internet in Social Studies. The following table examines the dark side of the Internet.

Instructional uses for the Internet seem to be growing as fast as the Internet itself, A small sample of myriad activities and limitless possibilities Is presented here.

1. Co-development Projects: Students in Social Studies get together on-line to plan and produce joint projects such as newsletters on current events, historical summaries based on family interviews, or exchange of local Cultures.
2. Research projects: Students can locate information on the Internet to answer specific questions on topics of interests. Students can present their findings in the class and follow by critical discussion.
3. Teacher Discussion Groups: Some sites have set up for Social studies teachers to have on-line discussion groups in which teachers can exchange ideas, advice and information on a variety of topics.
4. In-service Education Opportunities: Workshops, strategies session, tutorials and even full courses are becoming increasingly available via the Internet.
5. Electronic Field Trips and Guided Tows: Virtual trips are designed to explore unique locations and interesting subjects. For instance, Africatrek covers a ten thousand mile bicycle journey from Tunisia to Cafe Agulhas in South Africa. It provides a unique opportunity for students to learn about one of the world's most misunderstood continent.
6. Social Action Project : On-line communication provides students access to people in other parts of the world that can support social problem solving. In this type of participation, students are addressing important global, social, political, economic, human rights concerns or environmental conditions. For Instance, students collaborating on peace Issues write to the members of parliament to voice

concerns regarding land mines and present their viewpoints.

7. Electronic Penpals: Sending and receiving electronic messages is still the most popular use of the internet. Students can correspond with students Informally (penpals) or as a part of Social Studies assignment. Once using e-mail, students can exchange messages across the country or around the world at little or no cost. Electronic penpals is the simplest activity. Each student is linked with a partner whom the student writes letters which has been shown to be very motivating. It appears that networking in this way also eliminates social bias regarding race, gender, age, colour and physical appearance. E-mail can provide an important way to begin developing awareness of and appreciation for other cultures.

There Is no denying the fact that the Internet has the potential to provide social studies teachers with a tool that can lead to significant changes in the nature of classroom instruction and learning. The student exploration of vast amount of information in a global scale raises many questions about what kind of information is being accessed, what is being done with it, how to examine critically and make sense out of it and when it becomes too much.

Without instruction and practice Is how to critically examine and make informed choices about the material being collected, Information gathering can become a mindless exercise. This sort of information gathering does little to promote critical mindedness, historical thinking and understanding. The Internet is a vast resource for obtaining information available in the form of graphics, text, sound, and video. The information varies considerably in difficulty, accuracy, specificity, authenticity and quality. Also, unlike textbooks or encyclopedias, the content of the Internet is, by and large, unedited and unrestricted. We do need a framework for evaluating the Internet information. The following criteria for evaluating information has been developed by synthesizing criteria given by Katz 1992, Ryder and Hughes 1997, and Kirman 1997. For evaluating the Internet materials, Social Studies teachers have to teach critical thinking skills and information processing skills.

Through the study and careful examination of the Internet material, students realize that errors exist because of biases and different frames of reference. Teachers should teach the skills of the historian to detect bias in the Internet information as they do in historical context. Bias means a predisposition to a particular point of view. Biased Information presents a partial view of a situation. Table on the next page presents 'How to Detect Bias in Information'.

The World Wide Web, set up in 1992, allows users to connect or link to any one of the thousands of resources throughout the world with a single mouse click. Netscape is the most common software program for searching or browsing the Web, although others are available. Pages are files containing text, pictures, graphs, sound and animation that someone or some organization has made available on the WWW. The more popular reference to a "home page" has two meanings. It is the first page that opens when you log onto the Web. But each person's or organization's Web site is also called its home page.

Many Web sites have links which are like threads in a spider's web which gives the World Wide Web its name. The University of Saskatchewan, College of Education Internet Home Page entitled Classroom Teaching Ideas,' which has over 300 links to other Web sites, is located at: http: / /www. usask. ca/ education/

barneet/ barnett.htm. Social Studies Teaching Ideas provide links to TV and Newspaper sources around the world as well as 'lessons, units and strategies of teaching'. A Social Studies Web page at the University of Alberta (http:// www. quasar. ualberta. ca / social-studies / uasshp. html) has been created to encourage the discussion, development and exchange of ideas between Social Studies teachers at the Secondary level. A few more selected Web sites for Social Studies are given below :

National Council for Social Studies (NESS) On-line : http// www. ness. org/ on-line Social Studies Sources: http://www/haleyou.com/howleving/ social. studies htm

Internet resources for social studies

Educatton:http:www. indiana. edu / -ssdc /internet. html Katty Schrock's Guide for Educators (Social Studies) : http:// www. capecod. net/schrockguide /Web 66 (lists K-12 schools with homepages): http://web 66.gled. umn.edu/schools.html Gateway to World History : http./ /neal.etstate.edu/history/world history

Geography: Virtual Tourist II World Map:http: / / www.vtouristcom/ vt/

ERIC Social Studies Gopher Menu. Gopher: // ericir.syr.edu:70/11/ lesson/ subject/ social studies

Internet-related guidelines for social studies teachers

1. The acceptable use policy in the school with clear objectives, conditions, tales and consequences of breach of rules should be developed.
2. Students and teachers should be impressed upon that the use of the Internet is a privilege, not a right, and the misuse or inappropriate use will result in a cancellation of those privileges.

3. Everyone who uses the Internet should be expected to abide by the generally accepted rules of network etiquette such as politeness, appropriate language and ethical use. Ethical guidelines are needed not only for the users of the Intetnet but also for the publishers of those materials on the Internet.
4. Teachers should ensure that students have requisite skills so that students can focus on their research.
5. Teachers should ensure that students have critical skills to evaluate the credibility, accuracy, validity, and worthwhileness of the information from the Internet. Abundance of information makes the teaching of critical thinking skills more vital than ever, given the accelerated rate of Internet use by schools and individuals. Unless students are prepared to make use of critical thinking skills as they download data, they can be easily manipulated into accepting misleading and erroneous information.
6. Teachers should ensure that the Internet-based teaching and learning help promote meaningful, Integrative, active and challenging social studies.
7. Students should be made aware that the Internet-generated information reflects the programmer's cultural, gender, and ethnic bias. They should be skilled to detect that bias.
8. Social Studies teachers should be prepared to deal with plagiarism and cheating.
9. Social Studies teachers should develop models of moral education and curriculum material for dealing with what their students encounter on-line.
10. More research is needed to determine if students have learned from spending time at a Website or engaging In e-mail discussions and what difference that learning might make.

5

Interactive Multimedia

A highly skilled workforce is one of the greatest assets that a business must possess to remain competitive in today's world economy. Knowledge and skills must be passed from experienced employees to less experienced or newly hired employees so they can successfully and safely perform the tasks at hand. Traditionally training or retraining of employees was accomplished through on-the-job training (OJT) or in a classroom setting.

An advantage of OJT is that the less skilled employees can work with experienced employees in the job setting and can gain insight into specific job requirements. A disadvantage of OJT is that the senior employees can not fully focus on their daily job duties and productivity may be reduced. This disadvantage, coupled with the fact that OJT training is unstructured and many times unevaluated may lead to a training environment that is not beneficial to the unskilled employees. A traditional classroom setting may present the basic skills needed to successfully function in the work environment but may not allow "hands on" training with the equipment necessary for successful completion of the task at hand. Thus, most classroom training must be supplemented with OJT before the new employee can be fully integrated into and successfully function in the work environment. Many times classroom training is less efficient than OJT because a full-time trainer is needed for classroom presentations or a skilled employee must leave his or her work environment to do the classroom training. These two major problems with traditional training spur many companies to seek alternative methods to keep their employees current with changing technologies. Training problems of this nature were a concern for Bethlehem Steel's Burns Harbor 80" Hot Mill steel production area.

A major technological change, coupled with a workforce that included many employees rapidly nearing retirement, led Bethlehem Steel to seek alternative training methods. One method considered was interactive multimedia (IM) because it could efficiently train employees in vastly different environ-ments and also could store knowledge, experience, and skill sets that were going to be lost through employee retirement. Although Bethlehem Steel was interested in IM, none of its employees had experience in the development, evaluation, and implementation of interactive multimedia training. This lack of experience led Bethlehem Steel to investigate both private and public providers of interactive multimedia development and implementation. Purdue's School of Technology was given an opportunity to bid on a contract to develop interactive multimedia training for Bethlehem Steel. After winning the bid, the School of Technology and Bethlehem Steel formed a partnership.

In 1994, the dean of Purdue's School of Technology recognized the need and opportunity to partner with industry in projects that could result in a win-win relationship. Such projects had the potential to enable industry to work directly with Purdue faculty to solve problems, as well as provide School of Technology faculty and graduate and undergraduate students opportunities to work on real-world problems. To pursue such partnerships, the dean created the Center for Excellence. The center's director, a former CEO of a medium-sized company, has as his primary responsibility seeking partnerships with industries. The center director contacted the training center at Bethlehem Steel and described some of the expertise available through the School of Technology. The corporation had just initiated a major modernization project in its Burns Harbor 80" Hot Mill. Funds were allocated for the development of training materials necessary to upgrade the skills of the workforce as new technologies were implemented to change the electrically controlled steel process system to one that was hydraulically controlled.

After initial discussions, the Center for Excellence director and faculty submitted a proposal to provide workforce training in the 80" Hot Mill. The second phase of the project was creation of interactive multimedia training material to capture the training initially given to the steelworkers. Bethlehem Steel wanted to use interactive multimedia training CD-ROM to supplement the traditional classroom and on-the-job training currently used. The primary purpose of the CD-ROM was to allow both newly hired and experienced employees to learn or review the basic concepts of hydraulic fluid power and its applications to the steel mill on an individual basis. This would increase their understanding of the new technology and better prepare the employees for its implementation.

A secondary goal was archiving the knowledge of senior employees for future reference. Since a majority of the workforce at the Burns Harbor 80" Hot Mill was nearing retirement, the experience of these employees would be lost when they left Bethlehem Steel. Thus the interactive CD-ROM was one means of archiving the employee's knowledge and the unique operations of this steel plant for future training. The development of the

Bethlehem Steel CD-ROM was based on theoretical concepts of instructional system design to meet the need for individual utilization of this interactive multimedia technology training.

Interactive multimedia technology is any computer-delivered electronic system that allows the user to control, combine, and manipulate different types of media such as text, sound, video, graphics, and animation. The user is required to activate, manipulate, and respond to the presentation of instructional material and to control the rate and the route taken through the interactive instructional module. Instructional system design (ISD) is a systematic approach to the development of instructional materials in which the instructors, learners, and materials work together to create successful learning environments. This means instructional system design concepts and theories must be reviewed and used when interactive multimedia instructional packages, such as CD-ROM, are developed.

Instructional system design is typically a five-step procedure that consists of audience analysis, design, development, implementation, and evaluation of the instructional materials. Alternatively, Kristof & Satran state that successful instructional design products are developed when proven instructional theories are applied from the beginning and throughout product development.

Kristof & Satran maintain that the development of an interactive multimedia project is a process that involves three major development phases: information design, interaction design, and presentation design. Both of these instructional design theories were the basis for the development of the Bethlehem Steel 80" Hot Mill's basic hydraulic interactive multimedia CD-ROM. The first major phase of an interactive multimedia project is information design. Information design involves four major tasks: defining the needs of the audience, defining the product goals, deciding how the product will be delivered to the audience, and choosing the authoring tool. Once the four major tasks have been determined, the instructional product has been defined. Both Kristoff & Satran and Dick & Carey agree that audience analysis, the process of determining the target audience for the instructional materials, is one of the critically important initial steps of instructional system design.

Audience analysis involves defining who will use the instructional product; determining the user's skills, capabilities, and preferred method of learning, determining the environment and how the instructional product will be used; and, finally, determining what equipment will be used. Thorough knowledge of the target audience will greatly affect the design of the instructional system and can determine its ultimate success . Mohler states, "By analyzing the audience and documenting their requirements and interests, the developer ensures a more successful multimedia project." The users of this interactive multimedia CD-ROM were millwrights at the Burns Harbor 80" Hot Mill area. Their expertise ranged from inexperienced new trainees to highly skilled senior employees.

The average reading level of the millwrights for developmental purposes was assumed to be at a sixth grade level, but many of these individuals had attended community colleges and some had earned college degrees. The technology upgrade from electrical to hydraulic control systems was a major change to the steel production line. The millwrights were not familiar with much of this new technology, so their knowledge of hydraulic systems and theories was assumed to be minimal.

Once the audience has been defined, the design of the instructional material can begin. The design phase includes determining the instructional goal(s), devising performance objectives, and determining the strategies that will be used in the development of the instruction. The design team consisted of Bethlehem Steel union/ management employees and faculty from Purdue's Technical Graphics and Mechanical Engineering Technology departments. Team members concluded that the two major goals of the interactive CD-ROM were the initial training of steelworkers in the basic concepts of hydraulic fluid power and archiving the skills and knowledge of experienced millwrights.

The implemen-tation strategy was accomplished by developing two different interactive instructional multimedia CD-ROMs. The first CD-ROM focused on instructing entry-level and senior millwrights on the basic theoretical concepts of hydraulic fluid power. The second CD-ROM was more applied in that its goal was training millwrights on the specific applications of fluid power implementation at the Burns Harbor 80" Hot Mill facility.

The discussion of this chapter is on the design, development, implementation, and evaluation of the basic hydraulic fluid power CD-ROM. The instructional goals and performance objectives of the basic hydraulic fluid power interactive instructional CD-ROM were to: 1) develop an understanding of fluid power-, 2) develop an understanding of pressure and flow; 3) identify and understand the functions of various components of hydraulic systems; 4) understand the basic functions of hydraulic fluids; 5) understand the basic function of hydraulic pumps, 6) understand the basic function of a hydraulic actuator; 7) understand the basic function of controlling flow; 8) understand the basic function of controlling pressure; and 9) understand the basic function of control and servo mechanisms. After the instructional goals and the design strategy were developed, the creation of the CD-ROM began.

Development of instructional materials was based primarily on the overall goals of the instruction created during the design phase. Lowell contends that any successful interactive multimedia project developmental phase must be based on established developmental objectives. Lowell states, "Objectives describe where the project is going, how the design team will get there, and how they will know when they have arrived." He further adds, "Focused goals and objectives lay the groundwork for all subsequent dedicated actions.

A question that should be asked for any project-related task is "Does this action help to achieve the defined goal or objective?" If the answer is yes, then proceed with it; if the answer is no, then determine why the task is being proposed. Without clearly defined goals and objectives, the project may proceed without any idea concerning what is to be achieved. In combination, goals and objectives are vital to a successful IM title design. Using these guidelines the design team was divided into two groups to develop the instructional materials.

The first group was a team of Bethlehem Steel Corporation millwrights coupled with two faculty members and three undergraduate students from Purdue's Mechanical Engineering Department. They were responsible for the objectives and accuracy of the content materials and developed these materials and the scripts. A group of instructional designers and curriculum experts from Purdue's Department of Technical Graphics was responsible for the design and production of the CD-ROM, using the content materials and scripts provided by the content team.

The project director, a technical graphics faculty member with expertise in instructional systems design and curriculum, coordinated the work of all parties involved in the CD-ROM's developmental stage. He was responsible for the project's timetable. He made sure deadlines were met, scheduled meetings, and served as an arbitrator when a difference of opinion occurred. Ultimately, the project director was responsible for the success or failure of this project. The interactive multimedia CD-ROM development was the responsibility of the Department of Technical Graphics at Purdue. A team of undergraduate and graduate technical graphics majors, hired and directed by the project coordinator, included the following job descriptions.

The production manager, a graduate student, reported to and worked with the project director. He was responsible for the coordination of all tasks and production deadlines. The production manager also worked closely with the content experts to ensure that the content and "feel" of the instruction was reflected by the interactive multimedia CD-ROM. Six undergraduate students were technical illustrators. Working from rough conceptual sketches, they developed the technical illustrations for the CD-ROM. They reported to the production manager and also worked closely with the project director to make sure that the illustrations accurately and professionally reflected the concepts being represented.

Two undergraduate students were technical animators. Like the technical illustrators, the technical animators were given rough conceptual sketches. Reporting to the production manager, they also worked with the project director and, in some instances the content experts, to make sure that the animations accurately and professionally reflected the concepts being represented.

Two students were involved in the production of the audio for the CD-ROM. One student, a broadcast journalism major at Ball State University, used a professional broadcast studio to record the technical content scripts. After the audio tracks were recorded, a Technical Graphics graduate student digitized them for use in the CD-ROM. After a specific unit was completed, the production manager combined all of the elements into the multimedia environment with the authoring tool Macromedia Director. As the units were individually completed, they entered the evaluation phase.

Two types of project evaluation were used: formative and summative. Formative evaluation was used throughout the development of the CD-ROM. The first formative evaluation was of the content scripts. Each script contained performance objectives, the content material, a unit end test, and illustration and concept sketches. A technical writer reviewed and revised the scripts. After revisions were made, the scripts were professionally recorded and digitized. Concurrently, the illustrations and animations were developed for each unit and also were reviewed by the content expert team. Revisions were made to these and the content expert team gave its final approval. The entire unit was then compiled into a working interactive multimedia unit. Each unit was evaluated by the content expert team with suggested revisions for improvement.

The final revisions were made to each unit and both the content and production teams signed off before releasing the unit for the second formative evaluation, Beta testing. Beta testing was done by a Bethlehem Steel evaluation team of union and management employees. This team made suggestions for revisions to the development team, which then determined if these recommendations merited revision to the CD-ROM. The production team then made final revisions and

Bethlehem Steel signed off on the units for training purposes. After all the units completed the formative evaluation process, a final interactive multimedia CD-ROM was produced. Summative evaluation occurred after the interactive multimedia CD-ROM was used in training. Suggestions for debugging and revising the CD-ROM were logged through a questionnaire given to each trainee after completing the basic hydraulic CD-ROM training session. The questionnaire was based on the major goals established during the analysis stage.

Some organizations may choose to not provide training, thereby avoiding the loss of time from the job. However, without training, the people within these organizations will continue to work at their current performance proficiency level. If the current or actual proficiency level is less than 100%. The dollar value of the difference between 100% performance proficiency and the actual proficiency level is defined as the cost of nonconformance or CONC. Calculating CONC is a quick and easy way to preliminarily cost-justify training. The CONC is simple to calculate for some job categories, such as line workers, telephone operators, or salespeople, because these jobs are measured in a straightforward manner. Many other jobs, however, have a variety of variables which make it difficult to assign a dollar value to performance. An alternative is to use the cost of performance as a baseline—that is, the labor dollars it would cost to achieve 100% work proficiency.

Time in training

The data used to calculate this is as follows:

— number of courses taken in one year
— course length (# of days)
— number of students in each class
— number of times the course is held

- — geographic location of the course
- — average travel and per them expenses
- — average annual salaries
- — fringe benefit percentage
- — number of annual working days
- — lost opportunity costs

The definition of each of the above costs is straightforward with the exception of the cost of lost opportunity. This term can be defined as "the value of the reduced productivity or time lost due to absence from the job".

There are several ways to calculate lost opportunity. If a temporary worker is assigned to fill in for the staff member out for training, then lost opportunity equals the daily salary of the temp times the number of days of the training. If you believe the temporary worker will not perform up to the staff member's standards, then include a slowdown factor in your equation. Another method is to calculate the amount of dollars the staff member contributes to revenue for the organization on a daily basis, and multiply this figure by the number of days of the training. If coworkers are expected to cover for the staff member out on training, factor in the reduced output.

The following equation can be used to calculate the cost of time for training:

> Average student daily salary = (Average student salary + fringe benefits) /# of annual working days
>
> Total travel days = travel days * # of courses taken in one year
>
> Cost of training time per student = (Average # of days in training + Total travel days) * (avg student daily salary + avg travel expense + per them expense + lost oppty)

Cost of training time for all students = Cost of Training time per student *# of students

Given the following data, let's calculate the co of training time for all students:

number of courses taken in one year	3
course length (# of days)	2
number of students in each class	20
number of times the course is held	5
geographic location of the course	2 Travel days
average travel and per them expenses	200
average annual salaries	$40,000
fringe benefit percentage	30%
number of annual working days	265
lost opportunity costs	$175

The cost of training time for all students is approximately $685,000.

Although the cost of delivering selfpaced multimedia training is less than live classroom training, the cost of developing selfpaced multimedia training is greater than live classroom training. In addition, not all training topics lend themselves to a multimedia delivery format.

A balanced mix of both formats provides training that is successful. If we apply a compression factor of 30%, the cost of training time is reduced from $685,000 to approximately $479,000. This reflects a savings of $206,000. Storage Technology provides training to its 1, 500 field technicians. The technicians were required to travel to Colorado for 4 to 10 day lecture/lab training sessions. The traditional live training classes were converted to a multimedia format. Training was delivered in local offices rather than at a centralized location. A comparison of training costs over three years showed costs for lecture/lab at $3.2 million versus multimedia at $1.7 million, a savings of $1.5 million.

The reasons cited for the reduction in training costs were compressed training time and reduced travel & expenses. Andersen Consulting puts its new hires through "Business Practices," an intensive training course, before they work with clients. Initially, training takes place in a local office. Trainees then travel to a centralized training facility to complete the course. Andersen converted "Business Practices" to a multimedia format, delivered locally on CDROM.

Training time was reduced from 60 hours to an average of 24-40 hours. Andersen estimates in order to help sales representatives perform their jobs more effectively, Apple Computer designed a multimedia on-line sales information system. Apple estimates that the system saves each sales representative an average of 11 hours per month in time spent searching for information.

Consider the following scenario. It's a sunny day. You are walking along a crowded sidewalk in a major city centre at rush-hour. People hurry past you. Others stand window-shopping. There's a queue outside a theatre beside you. A hot-dog vendor is there taking orders. Nearby the traffic lights change colour and walking lights begin to flash. Just then you are startled by the honking of dozens of cars and trucks in a traffic jam. A traffic constable blows a whistle and waves the traffic through the intersection. In this scene, and others like it in everyday life, we know that we become less efficient when we are forced to divide our attention between competing sources; we experience a kind of sensory overload. This overload is what environmental psychologists call 'cognitive chaos'. Cognitive chaos has been associated with interactive technology as well. Knowledge acquisition in hypermedia systems is a problem when learners are required to do several tasks at one learning trial that require the storage, transfer or evaluation of discrete pieces of information. The effect constitutes a cognitive overload which requires a high memory demand. In brief, we become less efficient as we divide our attention between multiple messages and sources of important information. What can we do to retain our efficiency and reduce cognitive chaos?

Early theories of attention, such as that of Broadbent emphasized that people are extremely limited in the amount of information they can process at any given time. A common metaphor in these early theories of attention was the bottleneck concept which proposed that there is a narrow passageway in our working memory that limits the quantity of information to which we attend at any one time.

Neisser disagreed with this overall limit to our capacity for information proposed by the bottleneck theories. Whereas we can become less efficient as we try to focus on several things at once, our efficiency can be increased with practice and environment design. Currently accepted theories of attention in the cognitive disciplines state that there are different kinds of attention relative to the difficulty of the assigned tasks and the familiarity of the content under study. On easy divided-attention tasks with familiar items, we use automatic processing also known as preattentive processing.

Preattentive processing of divided-attention tasks can occur in parallel; that is we can handle two or more items at the same time. We implement preattentive processing on divided-attention tasks for easy tasks or with highly familiar items. On difficult divided-attention tasks with unfamiliar items we use controlled processing also known as attention focusing . Attention focusing on divided attention tasks is serial; only one task is handled at a time. We tend to use attention focusing on difficult or unfamiliar divided-attention tasks. This kind of attention has been described as the glue that binds the separate features of a stimulus - such as the colour and shape- into a unitary object'.

When we pay attention to a visual stimulus, cerebral blood-flow studies shows increased activity in the Visual and parietal cortex. When we shift our attention from the visual to the auditory modality our blood flow is increased in our prefrontal cortex. In this way we gain and hold our own attention, whether it is a response to an emergency message or the beginning stages of a lesson. When our attention is overloaded or distracted, features can be combined inappropriately.

Attention is critical to learning; without it there can be no learning. Designers typically seek to obtain and maintain our attention . Attention sustains our vigilance with sensations, regulating the search and enhancing our sensory acuity that makes us aware of any new cues. Good thinkers can readily apply attentional focus, even in the face of distraction. Kuhl refers to this ability to insulate goal-directed cognition from distraction as 'action control'. Good thinkers can inhibit inappropriate responses and are appropriately reflective thinking through problems rather than reacting impulsively. Even so, they are not reflective to the point that reflection is paralysing and always considering rather than acting.

Nevertheless, even good thinkers can not apply attentional focus in every situation. Stress, lack of sleep, personal problems or multiple stimuli can reduce attentional focus. In these situations, software developers can help us to maintain our attention by influencing the display from the educational technology perspective. Whenever we decide to read an assigned history chapter, watch a science demonstration or listen to an explanation of a numerical computation, we self-initiate a system of information processing. As we attend to these materials, we are holding the unprocessed sights and sounds momentarily before they fade away. These sensations linger long enough for us to associate meaning to them.

Early forms of instructional technology usually presented unfamiliar visual and auditory stimuli to learners. Users were required to control their own processing of these separate sensations. At that time, little was known of the effects of auditory manipulations on language teaming. 'The preoccupation with visual information is a deliberate effort of the communicators on the assumption that the sound will take care of itself. But experimentation shows that sound does not take care of itself'.

Consequently, early approaches to learning from auditory-visual delivery technology was found to be *ad hoc,* unproved and required frequent re-examination and clarification. Human interactions with technology were often explained as a function of playback system performance instead of how learners divided their attention on difficult and unfamiliar tasks. Today, some thirty computer applications permit users to annotate their silent applications and curricular software with as many as 1,024 commands per application. 'Sound is a great attention-getter, one that can lure us to dig deep into a newly discovered Website'.

In keeping with this trend, developers and users are dividing their important messages between the visual and auditory channels of their favourite software application, computer-assisted instruction (CAI) prototype or web service. 'Until now, bandwidth limitations and the large size of audio files has made it impossible to use the World Wide Web to access audio content efficiently and reliably. Newer technologies make more efficient use of the bandwidth available, which in turn makes it possible for you to enjoy the sounds of the web'.

Despite this resurgence of interest in audio design, guidelines for its implementation are still explained as a function of playback system performance instead of how learners divide their attention on difficult or unfamiliar tasks. These other recent explanations for adding sound to formatted text, graphics and moving images can be classified into one of two types: stochastic sound roles or the Structured Sound Function (SSF) model. The stochastic sound roles are discussed first.

In general, stochastic sound roles usually distract users' attention away from difficult or unfamiliar tasks. The following discussion about stochastic roles for sound is intended to highlight several issues that are frequently obscured by current practices in educational technology research and development.

In stochastic cueing, the user's attention momentarily shifts to announcements, designed to 'provide forewarning rather than concurrent information'. Intuitively we believe that cueing with music, effects or words must be an effective way of using sound in educational technology. However, stochastic sound cueing in educational software is problematic. One problem with it is the inability to 'activate or deploy attention [as an] expanded instructional event'. In other words, the stochastic sound cues require the user to switch the focus of their attention to the punctuated announcements which in themselves do nothing to actively employ the user. An oral advance organiser, for example, is a form of cueing with sound in educational settings to gain attention.

Oral advance organisers, however, have shown disappointing results in educational research. The reason is that oral advance organisers in themselves do nothing to engage the learner. From a user's viewpoint, this means there will be more sensation to process. From the designers' viewpoint, it means imprecision and a serious lack of prescriptive information. A related shortcoming in the design of some software occurs when a user's attention is divided between mixed messages. This is another example of a stochastic sound cue that requires us to switch the focus of our attention back and forth between conflicting unintended messages.

Speech synthesis programs like 'Speak and Spell' for example, which offer children practice in sound and letter matching, pronounces words as the child types them. In Daiute's study bleeps from the program that were intended to cue the student denoted that either the child's input was incorrect or that a particular word was not part of the program's limited vocabulary. Double meanings from single sound cues resulted in several incorrect interpretations by the children. Surveys of stochastic sound cueing that divides our attention have reported inconclusive findings.

Weiner investigated the differential effects of presentation conditions; visual only and visuals cued with speech, on sight-word learning with 55 handicapped third graders. The results indicated non-significant statistical differences between the presentation conditions. It seems possible that the implementation of a repeated measure by treatment design contaminated the visual-only treatment with memory traces from the speech treatment. Repeated measures in speech research should only be implemented by occasion, and then only after time lapses between occasions. Two years later, however, Weiner reported different results with 24 junior-high students using a Listen and Learn Speechware program. The purpose of the study was to investigate the effects of digitized speech components on mildly retarded adolescents' accuracy to target sight words and to orally read the targeted words; an indefinite role.

Unlike Weiner's repeated measures study, the visual only group received directions and word presentations without access to the auditory high-quality female spoken cues presented to the visual/auditory group. The results showed that computer-based sound cueing increased mildly retarded adolescents' accuracy with target sight words and their ability to orally read target sight words. It seems, then, that the implementation of a repeated measure by treatment design in Weiner's study contaminated the visual-only treatment with memory traces from the audio treatment. It ,appears that the cueing role for sound remains unproved in terms of its effectiveness in educational software at this time. Cueing without a function for the sound, therefore, should continue to be referred to as simply a stochastic role for sound.

Message redundancy is the second stochastic role for sound described in the literature. In message redundancy, our attention is divided by sound that restates messages already presented in text or graphics without providing any new information. This appears to be an opportunity lost; identical information presented from different sources. Usually, when a message is made to be redundant and two communication channels are prescribed, audio takes the redundant role. Redundant Sound has been widely-implemented in education.

The rationale for its use in education is to protect information from errors by increasing the redundancy of the messages. Another educational implementation of message redundancy is called audio accompaniment. Compu-terized audio accompaniment is usually considered to be an asset. Simple audio accompaniment is thought to decorate, enhance, reward and represent that which would have otherwise been less effectively communi-cated as words or numbers. In practice and research, however, redundant sound simply splits the user's attention unnecessarily between two sources that provide identical information.

When humans are included as message receivers in educational systems, or in emergency message systems, an increase in information redundancy has not always increased the control over their behaviour. Cottom attributed poor results to the novelty of digitized speech. Issak found that the addition of audio accompaniment resulted in nonsignificant statistical differences between the groups in either reading or listening skills.

Message redundancy tends to portray learners as automatic controllers with the goal of matching their outputs to performance objectives. Comparisons between mechanical and human learning systems have drawn criticism of the message-receiver model. 'The learner is no mere receiver of transmitted information as implied in the engineering model of human communication but an active processor of it who interprets the world in characteristic ways determined by his background and personality'.

Moreover, educational software is often criticized for ,a widespread lack of creativity and innovativeness' in a time when innovation is required to ensure that the computerbased information is understood. This criticism includes the tendency to explore better control principles rather than cognitive states, and a predisposition for representing learning in hierarchies of discrete chunks of information, rather than creative or interpretative enterprises. The physical evidence of interaction with software is considered to be less important than the cognitive activities that the lesson is designed to engender. A richer understanding of the technology's attributes is also required. 'It is no longer adequate to simply describe interactions in terms of either the input technology employed or the physical characteristics of the responses made. These will certainly change over time. We need a richer understanding of the psychological requirements associated with instructional tasks and responses and a sense of how to extend design science beyond the methods that have evolved through the years'

An assumption of redundant sound in educational software is that the information channels are attribute free; that the software is merely a vehicle for conveying the information. The opposite position is taken in this paper; that the purpose and place of sound can affect the information conveyed.

Computer sound should convey the kind of information about events not visually attended to, and can help to reduce visual clutter, making for a synergistic relationship with the visual information. When the auditory-visual relationships are made to be synergistic, the effects can offer learners a better alternative to redundancy. Cooperative action, in this sense, presumes active participation by the listener/ viewer. 'The most interesting questions have no agreed-upon answers. The software should encourage students to explore a variety of possible answers'. Active exploration by learners, therefore, requires something more visually complementary than message-redundant computer-sound.

Oral reporting is the third stochastic role for sound described in the literature. Oral reporting divides our attention consistently over the entire duration of interaction with the software. Oral reporting is intended to provide us with continuous synthesized speech with a specific purpose. Brown used oral reporting 'to replace what could easily be displayed in a visual view to allow users to focus their attention on other visual views'.

Warning systems multidimensional audio windows management, environmental sound postcards are other examples of the reporting role for sound. Insofar as the reporting role seems to be an improvement over redundancy, it still requires the users' selective attention and correct subsequent action, sometimes as overlapping tasks. Overlapping, for example, has become a job skill requirement for all telephone operators and some taxicab drivers. Overlapping for telephone operators involves the instantaneous and simultaneous discrimination, classification and response: (1) from a visual display-, (2) continuous computer-based verbal cues or requests; and (3) the constant 'live' verbal inquiries from their peers, trainees, visitors and the supervisor -a Point Of View Sound Function.

Overlapping, for some cab drivers, requires the additional activity of attending to continuous synthesized speech that reports the whereabouts of other cabs and new fares within designated zones - a Locale Sound Function. Overlapping seems to encourage similar multi-tasking capabilities for users. However, the simultaneous requirement for human attention to presentation modalities and task requirements has contributed to confusion in some important computer applications. Perhaps the most serious confusion occurred at the Three Mile Island plant where several different warning systems were activated simultaneously.

Something more decisive than an oral reporting role is required to help us to pay attention to several tasks by distributing our attention between more than one competing message or source.

Auditory feedback is the fourth stochastic role for sound described in the literature. Auditory feedback is intended to slow down our interaction with the software by requiring us to shift our attention between new and old program design opportunities. As a consequence the novelty and challenge offered by the new program design opportunities simply replace the controlled processing required to focus on the old. 'Although aesthetically pleasing, feedback provided in text can go unnoticed by the student'.

A corollary to this concern is that when feedback is provided following errors, it is often more interesting than feedback following correct responses. Generally, auditory feedback schemes using computerized speech have reported mixed results. The positive results will be discussed first, beginning with Autoskill. Autoskill is a computer-assisted remedial reading program. During oral reading training with Autoskill, the student responds orally to stimuli on the screen. There are opportunities for teacher remediation.

During auditory-visual matching training, students respond with key presses. Student errors are presented and auditory stimulus is repeated without teacher remediation. Finally, during visual matching, students respond with key presses. Student errors are presented without teacher remediation. Results of studies showed improvement in reading in language lab settings for special education learners and for students of English as a second language. Jordan has also reported subsequent improvements using Autoskill with a wide range of target audiences. Sixty students aged 20 to 35 years of age taking basic skills training at Humber Community College received an average of 27 hours of training with the Autoskill reading program. They gained an average reading grade of 4.7 in word-attack skills. Forty incarcerated males in Dade County, Florida, were placed on the Autoskill remedial reading program for 30 hours over a 90 day period. They achieved an average of 1.8 grade improvement on tests of reading comprehension. Young adult Hispanics in an ESL program in California gained on average 2.7 grades with 17.5 hours using Autoskill reading program.

Young, single mothers, who were high school drop-outs, enrolled in a United States Federal Job Training gained an average of 3.6 grades ill 9 hours of training with the Autoskill remedial reading program. In another reading program using auditory feedback, Ross addressed the problem of the poor readers' inability to decode print adequately. A sample of 32 students from an inner city school were selected. Ross found that speech feedback was associated with improvement in reading of individual words.

Subjects 'with speech feedback' made statistically significant greater gains in reading voiced words than those without voice feedback'. Moreover, subjects 'with voice feedback' made significantly fewer errors than those 'without voice feedback'. Similar results were attained elsewhere. Anderson Inman gave 58 third- to sixth-grade reading disabled students whole-word, syllable, subsyllable and mixed auditory feedback for unknown or difficult words. On the word recognition tests, students using the auditory feedback system significantly outperformed the control group who did not use the system.

In a different study, however, Zender's dissertation research with 41 business communications college students reported statistically non-significant learning effects from varied amounts of verbal reminders in a computer-assisted instruction (CAI) self-monitoring program. Zender attributed these findings, however, to differential prior knowledge between the groups, uncontrolled time on task, lack of a definition for 'minimum practice', improperly operationalized reminders, not implementing covariate measures, and students that were not taught the appropriate self-monitoring skills.

Shilling's research with 81 kindergarteners reported statistically non-significant learning effects between students using stochastic writing materials and/or computers with and without available synthesized speech feedback over an eight-month period. It seems possible that the implementation of a repeated measure by treatment design, like the Weiner Study, contaminated the visual-only treatment with memory traces from the speech treatment. It appears then that auditory feedback has reported improvements on learning low-level matching tasks. Such as auditory-visual, subsyllable, syllable and word matching. However, in studies in which learning was equated to other delivery methods, problems were reported in the design of the research.

In conclusion, it is clear from the above account that stochastic methods do not always focus attention on the competing tasks required in most contemporary interactive programs and on-line services. Stochastic sound roles that use digitized speech clips with formatted text, graphics and moving images relegate information delivered by the audio channel to novelty or accompaniment status, in which it is inappropriate. Researchers and developers cannot always find reliable information on how to focus attention on the competing tasks required in most contemporary interactive programs and on-line services. Even when information is found, much time is spent reading irrelevant material. 'There is a lack of guidelines for the proper use of audio in computer based instruction... Designers must decide if audio should replace, enhance, or mirror the textual information on a CBI screen'.

Sometimes the guidelines are too general or at least not generic to our needs. Usually we are forced to determine the trade-offs among conflicting guidelines. Guidelines are not sufficiently helpful in supporting decisions about new technology; guidelines lag behind the times, There is no predetermined syntax or structure to limit how skills should be represented. 'By effective design we can reduce the noise component and increase the information-providing potential of sound. Our ambition is to promote the acquisition of an understanding that will support the design of audio cues that will improve human performance in computer-mediated tasks: designer sound for computer systems'.

A more systemic model is needed for designing sound to improve learning with sound: 'designer sound for computer systems'. One model, the Structured Sound Function model was developed to fill this need; to prescribe principles that compliments formatted text, graphics and moving images and assist users in shifting their attention between the auditory and visual stimuli.

The Structured Sound Function (SSF) model is a parsimonious approach to applying purposeful sound to a videoclip, graphic or paragraph of formatted text. The model has only two attributes: sound structure and its functions. Unlike the stochastic roles for sound, the SSF model is derived from design principles, discussed later in the paper. The origins and applications of the SSF model are explained in Mann.

Structuring sound means describing or prescribing from among six levels of informational intervention with the image; from either of two roles for an emotional strategy; from a flexible pacing strategy, a continuous or discontinuous rhythm strategy; a spaced, massed, or summarized review strategy; and a convergent or divergent delivery strategy.

When the primary intent of the audio is to inform, one of the first four audio-visual relationships should be considered. These are substrategies that comprise the Informational Sound Strategies. Cueing, Counterpointing, Dominating, and Undermining can be placed along a relationship-to-image continuum. When the primary intent of the audio is to express emotion or to motivate, one of the last two audio-visual relationships listed in the second column should be considered. A choice of Reviewing and Delivery attributes are available for most static or moving visuals. However, Pacing and Rhythm attributes are not usually considered when the visuals are static.

Once the structural attributes of the audio have been assigned and the type of audio decided, then a purpose or function can be considered. Decisions about whether to use speech, music or effects should also be addressed at this time. Pacing has been used effectively in applications of sound to image in artistic, educational and entertainment audio visual environments. Appropriate dialogue cutting points, for example, can improve the smoothness of edits when cutting from one speaker to another in a hypermedium. The two Pacing sound substrategies prescribe how fast, where, and how often the chosen sound function occurs in the program. Sound pacing can be placed along the continuum; fast or slow, occurring in contrast with one another.

Two Rhythm sound strategies prescribe the periodicity for each chosen sound function in a script or sound mix for a desktop video clip. A Continuous rhythm substrategy places uninterrupted sound or interrupted sound at regular intervals throughout the duration of a node or between nodes of a hypermedia learning environment. A Discontinuous rhythm substrategy places uninterrupted sound or interrupted sound at regular intervals throughout the sequence or entire program. Massed, Spaced, or Summarized review strategies prescribe the nature of a particular function's reoccurrence in a sound-image node.

Contemporary corporate applications often use a Summarized review substrategy to reinforce behaviour modification role modelling techniques. Some digitized video news clips also use a Summarized review substrategy to recap the main stories. Personal goal areas on video clips or still graphics can be presented all at once and usually out of programme context using a Massed review substrategy. Problem-solving level skills can be effectively presented with a Spaced review substrategy. Convergent or Divergent delivery substrategies tend to fall along a continuum, their visual counterparts implemented in educational software to prescribe instructional events or learning activities. The application of convergent or divergent delivery methods to sound design is appropriate when applied in this context.

In a Convergent delivery substrategy, the designer or learner presents the questions and supplies the answers. In a Divergent delivery substrategy, the designer or learner must supply their own answers to controversial questions presented by the program. In sum, structuring skills are relatively common dramatic devices taught in creative writing and some production courses. Combined with one or more sound functions, these substrategies can assist the designer in prescribing how, where, and how often speech, music or effects should be applied within a sound image relationship.

Developers and user should be advised, however, that modifying structured functions of the sound attribute for learning can require as much time, effort and resources as designing the visuals for a hypermedia frame.

The process of assigning sound functions, like the structuring activity, should be case-based and conceptual. Sound functions may be conceptualized as possible prescriptions for character, place, time, or subject matter in a sound-image relationship. When the primary intent of audio is to orient learners about a future event or give feedback about a past event between nodes, Temporal sound should be considered. Future and past events require learners to use this knowledge to paraphrase or to make personal references.

Point-of-view (POV), Atmosphere and Locale functions are also assignable to most static or moving visuals. Objective, Subjective or Performer POV sound functions can be prescribed as a function of character. A whispered voice-over, for example, may indicate a Subjective POV sound function. A formal narrator voice-over can provide an Objective POV sound function. Cocktail party sound using some combination of subjective and objective voices would be one example of a Performer POV sound function.

An Atmosphere/Feeling/Mood sound function can be associated with the visual information presented in a videoclip, graphic or paragraph of formatted text to provide context. It should imply either more or something else about the atmosphere, a feeling, or a particular mood other than what has already been stated or implied about atmosphere, a feeling, or mood in the image. A Locale sound function fulfils an informational role when it is associated with the visual information presented in a video clip, graphic or paragraph of formatted text. Most often, familiar sounds are produced to establish a place. Usually, the Locale sound function is used realistically as appropriate background speech, music, or sound effect in a node. Character-related functions, namely Character's Past or Future, and The Character- in -the -character sound function, are usually assigned to moving visuals. Three types of Character's Past/Future sound are presented in this model: Personal, private and public. Character- in-the-character sound should be used to depict a certain recurring aspect of the character's behaviour, certain aspects of the character's (moral) character or when his or her peculiar personality (mask) is intentionally prescribed ambiguously.

A context-based approach seems most appropriate when applying elements of the SSF model to visual information. In the first context, the user or developer already knows the situation in which to add audio before its exact function or purpose. Here, a structure before-function approach is used for adding audio to the software. In the second context, contriving an audio situation is the most realistic approach. Here, a function-be fore -structure approach is used to add audio. See Mann for details on the two contexts for applying the SSF model with formatted text, graphics and moving images.

In general, the presence of a function and structure for sound is more important than whether the function or the structure is decided first. The systemic implementation of embedding the SSF model within a computer-based instruction (CBI) model requires that the researcher or developer considers the dynamics of the broader context of the instructional situation. In educational applications, the SSF model becomes a subsystem within a theory-based model of CBI.

The systemic requirement of subsuming the SSF model within a CBI model helps to ensure that the outcomes will focus learners' attention and elicit appropriate mental operations and behaviours. Alessi and Trollip's CBI model, for example seems well-suited for this purpose. The SSF model could appear at step five of their storyboarding level, namely: 'Draw and revise graphic displays, plan other output'. Other output comprises any presentation that does not appear on the computer screen. The most frequent and important of these is sound... Sound requires special consideration because it is difficult to describe on paper'.

The SSF model is both structured and flexible enough to accommodate most logistical constraints, particularly when rapid changes must be made without physically including them in the storyboard. In this way, sound can be fully integrated into the design of educational computing activities and not remain just another feature of it.

Several design principles account for how we read and listen to multimedia. These principles distinguish the SSF model from stochastic sound roles and have been evident where outcomes have been positive:

— particular model of human cognitive system;

— separate processing streams;

— synergism from the media mix;

— research controls for modality contamination; forgetting and reminiscence traces;

— gist is affected by ageing.

One design principle that distinguishes the SSF model from the stochastic methods is its application of Current theory about the structure of human cognitive systems. The decision to adopt one of these or some other cognitive structure appears to reside in the ,explicitness' and 'gist' requirements of the tasks and the interrelatedness of spatial and language representations.

'Unless the fundamental differences of information processing of these modalities is known, a variety of comparisons of different media seems hardly to be valid'.

Production system theorists for example, offer one perspective, namely, that:

1. humans have a unitary mental architecture;
2. the control processes governing the performance of mental tasks are relatively simple, and;
3. the processes governing human memory depend on symbolic rules.

The significance of a particular symbol in a system depends entirely on the rules in which it occurs, and these rules have to be spelled out with an explicit structure within the system. Applications of production system theory can be found in educational technology research on instructional design, message design and the ‚situated cognition'. Connectionists offer a different perspective; see the work on massively parallel computing by McClelland et al. Instead of production rules set in an explicit mental structure, they postulate holograms distributed over many human experiences which gradually become clearer as we proceed.

Applications of connectionism can be found in educational technology research involving generativity. Dual Coding theorists present a third view; that human cognitive systems should be conceptualized as having a dual coding structure. According to this view, linguistic (language-like) information and spatial (picture-like) information are processed through functionally independent, interconnected cognitive systems. Applications of Dual Coding theory can be found in educational technology research involving computer graphics.

Another design principle that distinguishes the SSF model from stochastic design approaches is that this model reflects current research about differential processing by readers and listeners, as suggested in the literature; . Listeners attend to tile gist. Readers attend to details, Surface features of the text, ~verbatim information. Hildyard and Olson also reported that performances are better for listening to highlights (gist) and reading the details (substance) ~verbatim. Others have found behavioural and neurological evidence that indicates distinct developmental paths for verbatim and gist memories.

A third design principle that distinguishes the SSF model from stochastic methods is that the SSF model recognizes Computer-Mediated Communication (CMC) as a 'media mix'. The CMC medium, including e-mail and computer conferencing, shares attributes of both oral and textual communication 'it's talking by writing'. Perceptible changes to treatment effects should therefore be expected when movable type is placed within an online learning environment. A study designed to test Hildyard and Olson's assumption about reading and listening differences mistakenly chose Computer-Mediated Communication (CMC) to represent the text condition. One treatment was partially contarninated by the inherently oral attributes of the CMC medium.

A fourth design principle that distinguishes the SSF model from stochastic approaches is that the SSF model requires adequate controls in both experimental and formative evaluation research. First, the SSF model incorporates modality-specific practice into its studies. Treatment effects are more likely to be detected when the research subjects are provided with adequate instruction and practice within the modality to be tested. Second, experiments and formative evaluations designed to compare memory for information from computer sound versus computer text or computer graphics ensure that the factors are either controlled or sufficiently explained. Researchers reporting negative or equivalent outcomes with computerbased speech with text attributed their findings to research design principles.

A fifth design principle that distinguishes the SSF model from stochastic sound roles is that the SSF model reflects advice about inoculations against forgetting and takes account of reminiscence effects, Working with sound can produce post-test inoculation effects against forgetting. This can occur when the visual only treatment is permitted to become contaminated with memory traces from the audio treatment. Studies of reminiscence effects indicate that sound groups can show improvement in their retention over their post-test scores following a latency period for private reflection. Interested readers should refer to the psychological and educational technology literature under 'reminiscence'.

A sixth design principle that distinguishes the SSF model from stochastic sound roles is that the SSF model accommodates the research on ageing, specifically the developmental stages in life as they relate to our biological capacity to extract gist from sound 'Perceptual learning theory highlights interactions between biologically determined potential and the environment'. Human memory systems that support the retention of verbatim information begin to deteriorate in early adolescence while gist information continues to improve. However, human memory for gist can compensate for poor verbatim memory, especially because gist suffices in a broad array of circumstances.

As the use of computer-based training (CBT) increases in schools and corporations, multimedia developers need methods to streamline the complicated and time- consuming instructional development process. One way to do this involves using automated instructional design software. Such automated tools can organize, control, and speed up the design and development of CBT, both for novice and expert designers. This survey sought to ask those involved in multimedia development about their willingness to use automated design software to produce CBT, and determine what features they feel are essential for these tools to become truly effective.

Three classes of multimedia development tools exist: (1) automated instructional design software, (2) programming languages, and (3) authoring languages. With automated design software, CBT developers use pre-designed templates to enter lesson content, embed questions and feedback, add graphics and sound, and establish record keeping procedures within the instructional program. After this entry process ends, the software automatically converts the information into stand-alone CBT, usually based on a linear design.

The person who inputs the information can be a trained instructional designer or a subject matter expert (SME). The SME without instructional design experience produces the CBT by simply using templates provided by the automated instructional design software. One developer of an automated design software product even boasted that its program was so simple that "anyone that can use a word processor can design a computer-based training course. The automated instructional design process differs from using either a programming language or an authoring language to develop CBT.

To produce instructional software using programming languages, the developer composes complex codes to create commands for text, graphics, sound, video, hyperlinking, and interactivity. This slow and tedious process challenges the abilities of even the most experienced instructional developers. Commercial authoring languages, on the other hand, combine some of the capabilities of the automated instructional design software with the flexibility of programming languages, usually in an object-oriented format. Using an authoring language becomes a very time consuming and costly process that requires quite an extended learning curve. The features of automated instructional design software vary, depending on the particular program. Some provide capabilities to design personalized templates, import graphics and video, incorporate sound bites, promote interaction, provide feedback, keep records on student grades, track progress, and bookmark a position for later return.

Developers of automated design systems feel that their software provides CBT consistency by incorporating similar backgrounds, providing templates for text formatting and graphic placement, and placing navigational buttons and title headers at the same location on each screen. Merrill, an early advocate of authoring support systems, developed a program that also guides instructional designers through the design process. His software queries multimedia developers about the task to be taught, suggests the structuring of content, recommends strategies, and indicates possible transactions such as practice sessions and tests for the students.

Fischer advocated that automated design software should include critiquing features that monitor the authoring activities and suggest alternatives when a selected design procedure may be inappropriate. Although automated design features seem the long-sought answer to tame CBT development, educational technologists have questioned the practicality and acceptability of such software. Butruille and Gayeski complained that automated software de-skills the instructional design process and stifles creativity. Richey and Nelson questioned if automated design software can support the cognitive processes necessary to develop and deliver effective instruction and whether novice designers will learn design procedures successfully if their only experience is using automated software. And, obviously, designers may wonder if such tools will replace their jobs, a concern that constantly emerges as instructional technology improves. In light of these issues, the overriding question is whether instructional designers will accept automated design software.

Methodology was developed by the ten national leaders of the Instructional Technology Forum of the American Society of Training and Development (ASTD). Based on their experience and on the issues identified in a review of literature, the team developed a questionnaire for the survey. The team purposefully limited the instrument to twelve questions on one page to encourage better participation in the survey. The investigators mailed the questionnaires to all 2,481 ASTD members who indicated on their ASTD membership application that their primary job role involved instructional technology. Any generalization of the survey results may be limited since the sample came from a single population-, that is, they are all members of ASTD. However, the membership of ASTD) encompasses multiple, international geographic areas and includes members from various fields, schools, and corporations.

Researchers received 481 completed surveys for a 20% return rate, significantly higher than the 10% rate that ASTD reported on similar surveys. Most of the respondents were instructional design administrators (30%). Others included instructional designers (26%), training facilitators (18%), and instructional developers (12%). The survey developers considered instructional designers as those individuals who develop the instructional strategies, flowchart, and sequence of the

CBT and classified instructional developers as those who perform the actual software programming. The experience level of the participants ranged from 3 months to 31 years with an average of 6.6 years. The majority of the respondents (45%) came from corporations. Others worked in private instructional design companies (19%), consulting services (8%), universities (7%), and software development firms (6%). Surprisingly, 76% of the participants reported they did not use any type of multimedia authoring tools. The main reason cited was lack of knowledge about multimedia authoring. Other reasons included the costs involved, the time involved, the task not being applicable to their job, the required learning curve, outsourcing authoring to outside developers, and a fear of technology. Those 24% who did use an authoring tool ranked convenience as their main reason, followed by the time saved, the availability of simulations, the costs involved, update ability, use for distance education, and record keeping capabilities.

A significant number of respondents (97%) indicated they would consider using automated design software in the future. The respondents ranked saving time as the main benefit of using automated tools. This was followed by providing consistency of instruction, improving the instructional design, saving costs, equipping the SME to be an instructional developer, and revising content easily. When asked what features they would prefer in automated instructional software, the respondents ranked instructional templates first. Branching and feedback capabilities tied for second, followed by access to help, graphics, linking capabilities, a way to distribute education, reporting capabilities, preprogrammed animation, and pre-designed test shells.

The final item on the survey was an open-ended question that asked if the respondents had any concerns about using automated design software. Although 231

(48%) reported no concerns, 250 (52%) listed a variety of issues. The survey team divided these issues into five major categories ranked in the following order: lack of flexibility, learning curve/time, using SME's as instructional designers, costs, and job displacement. Table 6 lists selected comments from respondents on these concerns.

The survey team also examined the relationship between the job roles of the respondents and their responses on two key questions: "How do you think you would benefit from an automated instructional design system?" and "What features would you want in an automated instructional design system?" Concerning perceived benefits, a significant difference between the respondents was found in two areas. First, administrators ranked saving costs as a benefit higher than the other respondents did ($p < 0.042$). Secondly, training facilitators considered equipping SMEs as instructional designers was far less of a benefit than the other participants did ($p<0.021$).

Concerning desirable features of automated design software, a significant difference was found only in one area; that is, instructional designers ranked branching as a more desirable feature than the other respondents did ($p < 0.009$). The obvious question concerning automated design software is if it will take jobs away from instructional designers. Despite this possibility, almost 100% of the respondents indicated they would consider using automated design software, indicating a considerable positive interest in this still evolving technology.

For developers of automated design systems, the survey indicates that for their product to be successful, it should be flexible enough so designers can individualize instruction. While templates help inexperienced SMEs or novice designers to develop linear CBT, experienced designers want options to create more robust designs. Future research could help determine which tasks can be automated, and which tasks may require creativity from human designers. To gain acceptance, the software should embed on-line help to shorten the learning curve. This includes wizards, prepared templates, examples, and ready-to-go samples. Additionally, as the popularity of world wide web expands, automated design systems must include connectivity to the internet.

Sugrue and Kobus report that such connections allow for updating of lesson information, exchanging data for recordkeeping, and cyperlinking to other on-line resources. Products such as VUEpoint's Performance Learning Systems (PLS) are now emerging to automate the design of web-based training. PLS offers templates and on-line training that enables web-based training developers to create javascript supported lessons easily. The role of automated instructional design systems in equipping SMEs to develop their own CBT remains controversial. Comments from those surveyed show mixed feelings, ranging from design quality assurance to job security issues. If SMEs unskilled in instructional design use automated design systems, they will need some type of intelligent, knowledge-based system to guide them. Such a system could analyze the instructional efforts of the SME, interrupting when a design error has occurred, and suggesting possible solutions.

For novice instructional designers, the automated instructional design software could include a solution library, hypertext database, and a design catalog for different learning strategies. Although only six participants mentioned job security as a concern, the finding that instructional administrators, who generally manage project budgets, were significantly more interested in the cost benefits than the other respondents shows that money remains an important variable in multimedia development. If it can be demonstrated that automated design systems do indeed reduce development costs substantially, administrators might use such systems to reduce the size of project staffs and lower multimedia development costs. If these cost-cutting procedures occur, the stated job concerns may be justified. The finding that instructional designers support the branching features more significantly than other respondents reflects the growing trend to develop non-linear software that allows more learner control. Such approaches complement the constructivist learning models that are described in Leidner & Jarvenpaa. While this study addressed the functionality and acceptability of automated instructional design software as an authoring tool, future research should probe its impact on the learning process itself. The cognitive achievement, time on task, and attitudes of students who use software developed by automated design systems should be compared to CBT developed by the other types of authoring tools.

6

Internet Education

Today the Internet is an ideal world for browsers. But it is entirely uninviting to the follower community. Followers represent by far the largest percentage of the population that consumes mass media. For the Internet to be truly populist and commercially successful developers must seek out new strategies for motivating and encouraging this much larger audience to feel at home on the World Wide Web. Internet users can only choose between active participation: clicking links for more information; and passive viewing: being force-fed video audio and animation with no opportunity to interact beyond stop play and rewind.

Passive/active inter-activity introduces the new class of user called the 'viewser' (viewer-user). The viewser has the option of interacting with the story-telling experience as it streams over the Internet. Viewsers can passively experience the presentation or actively interact with it. Essentially, the viewser has control over the story-telling experience which is more analogous to human communications or real life conversation then what currently exists on the Internet. Passive/active interactivity is quickly moving from emerging to commonplace as the Net matures. Innovative Web developers, multimedia producers, and broadcasters are using passive/active interactivity to introduce a new concept in story-telling on the Net. Arguably the document is not the most flexible or effective metaphor for conveying complex thoughts and information in a network setting. The linear process and creative methodologies associated with the development of generic Web sites has run its course.

The sheer volume of information that a user is expected to navigate on a modern Web site serves as a disincentive to actual and repeat use. Hierarchical and other navigational designs are insufficient in addressing this problem. This is a question that many Web site developers have been asking for some time. Every month a new trend in development with respect to tools and technologies is introduced in the general trade press resulting in an influx of new gadgets, wizards and glitz on pages circulating the Web. A compelling narrative thread is nonexistent in this new world of complex hypertext documents.

The entertaining narrative that could be used to guide an audience—of one or many—through the complex web of information that is a modern Web site. When trying to describe the problems of current technology, it is often convenient to refer to examples from a current, past, or perhaps more concrete world. Today's Internet deals very well with the browser. This class of user is quite accustomed to the challenge of seeking relevant information and making it personal. Browsers are both resourceful and curious, compelling attributes of the early adopters segment of any marketplace.

The follower, on the other hand, is not usually inspired by a large and potentially poorly organized mass of information. Followers are not likely to spend large amounts of time navigating through such a collection unless they are motivated in some way.

When arriving at the museum the browser audience rushes immediately to the stack of exhibit maps, pay their fee and marches right into the museum completely absorbed by the information surrounding them. Should they have questions they'll approach someone. The followers, by contrast, make their way to the information desk as the first stop.

There they would inquire about the necessary information required to insure their enjoyment at the exhibit and they would request information regarding tours and other special events. To address both audiences, the museum community has evolved two very distinct methodologies for conveying information about exhibits to their audiences. In the case of browsers, ease of admission, access to information, and the passive yet courteous staff is an ideal environment. For followers, the museum must evolve several forms of narrative to introduce and make easy and entertaining the experience of particular exhibits.

Followers can choose to accompany a human host as a tour guide through exhibits as a group—in which case certain critical elements of the follower's experience are derived from the discourse amongst other followers in the group. Equally convenient, the prerecorded audio tour available at most major museums serves as an appropriate and effective incentive to encourage the follower audience to enjoy information laden museum exhibits.

The most effective use of narrative as an introduction is to utilize simple stories to better target your audience. There are many evolving technologies for the personalization of Web content. These technologies also take both active and passive forms. Active personalization software requires the audience to complete certain questionnaires and activities so that the engine may better profile its interests and requirements. Passive personalization transparently tracks the progress of the audience through information and matches the activities of the audience to certain predefined profiles. Active personalization, depending on how the questions are structured, can be an impediment to even the most curious of browsers.

Passive personalization on its own provides even less context, and as a result no incentive, to both the browser and follower audiences. A combi-nation of active personalization and passive profiling, front-ended with targeted narrative, can provide a potential solution. A solution targeted at a new class of audience, or perhaps a combination of the browser and the follower: the viewser. To date the concept of true hypermedia has been absent from the Web. Certainly there are a plethora of links from textual information to other data types, but these links are usually out of context. At best the context of a text-to-audiovisual media link is constrained to the caption or textual descriptive information associated with the audiovisual clip.

Ideally audiovisual information can be conceptually linked with other non-time based data types on the Web. This basic synchronization or link integration is the first step towards conceptual hypermedia. Insofar as form, a story told need not change in this hypermedia environment. The developer of a hypermedia story is attempting to create two states.

The first state, inference, is integral to the nature of narrative. The main story, the beginning, or the opening should by its very nature suggest, or infer, additional information or linkage at various points in the narrative. The second state, fulfillment, is created when the viewser traverses a conceptual link following an inference. Inference and fulfillment in this hypermedia setting can be cyclical in that each subsequent linkage can form the beginning, the middle, or end point of an entirely new narrative thread.

In the case of a "power -shopper," the suggestive aspects of up or cross-selling should be masked entirely or contained within a value-added function on the site. Destination sites that contain hundreds of thousands of links, pages, and references could benefit tremendously from a complex, layered navigational narrative guide. In these cases, optional guide styles can be presented both based on subject criteria as well as any gathered profiling information. These options could be considered from a gender, culture, subject, or skill level perspective. An example might be a series of stories authored to guide an experienced wine connoisseur through an extensive online food guide. These stories might evolve from a situational or experiential viewpoint involving a person with like interests depicting scenarios that may infer certain areas of interest buried with the site; thus providing incentive.

The desktop is a place where, to quote the late Joseph Campbell, "The Power of Myth" is almost entirely absent. Yet myth, or the art of story-telling, is a very powerful communication paradigm. Most often people base their decisions on information they receive from others. The interpretation of those messages, those stories, varies based on a wide variety of factors including the perceived worth of the messenger, the completeness of the message itself, and perhaps most importantly, how the story is told.

The intonation, conviction, and passion of the storyteller has a great deal to do with how well messages are received and how those messages are acted upon. In the corporate context, the hypermedia story is a vehicle that has yet to be fully explored. The document is a limited metaphor for the creation and dissemination of complex messages, particularly where time is an important factor. The hypermedia story can be used to capture and convey complex messages in compressed time frames. Again, in this setting, the concepts of inference and fulfillment are critical, but of equal importance is the process of constructing the stories from a collection of complex, perhaps unrelated items of information. This corporate story-telling process at point of origin and in subsequent layers in the hypermedia web must be accomplished with minimal effort—less than the process of completing a form. In essence, the unstructured manner of information capture and presentation should be less complex than placing the same information into a well structured format in a document for universal consumption.

Using the internet as an interactive multimedia training delivery medium is an exciting possibility that has been promised for a long time. With the arrival of internet authoring tools, "streaming" and "push" technologies, and various internet plug-ins for playing multimedia, many are asking themselves if the CD ROM, and other more traditional methods of delivering multimedia, are not now becoming obsolete. We begin with a description of the training and a review of the business and performance needs it addresses.

Next, we review the delivery options considered by The Times. We conclude with a step-by- step look at the issues that influenced The Times choice of delivery system. The Times' course is called Increasing your product power, so named because the primary purpose of the course is to dramatically increase the product knowledge of marketers in Consumer Marketing Sales. This increased product knowledge leads to higher long-term retention among subscribers and increased circulation of The Times. The course was designed such that it can also be used by individuals of any other department at the Los Angeles Times.

Both The Times and Allen Communication knew that the delivery system chosen for the course would impact the effectiveness, appeal, and ultimately, the return on investment of the training. It was therefore important to review the strengths and weaknesses of each of the available options. Given the current excitement over the internet, one of the first options considered was an internet, or company intranet delivery. In fact, this was the only possibility considered at first, because the internet can reach many people at once, and because internet-based courses can be updated from one central location.

After exploring additional requirements for the course, including the desired amount of "flash and dash," and student tracking features, we also began discussing alternate delivery options, including delivery via CD ROM, hard drive, or LAN server. The internet is being used now more than ever as a means of disseminating information and facilitating learning. While it once consisted uniquely of text-only Web "pages," the internet now offers sound, video, and animation. It is now *possible* to send multimedia over the internet, it is far from practical. The reality is that piping multimedia courseware over the internet is like, as Rakow put it, "trying to shove a golf ball through a garden hose." This is because the big files-graphics, audio, and video-still take significant amounts of time to download.

When employees are required to wait for information to download to their computer, a "just in time" training course can quickly become a waste of time. The internet is being used increasingly as a means of distributing information. If the information includes text and/or small graphics, it can be successfully delivered over the internet. Company intranets are basically smaller versions of the internet, used for distributing information within a given company. Like the internet, the use of a company intranet for distributing multimedia is limited by the capacity of the server, the infrastructure, and the number of users. Depending on these factors, users may or may not have to spend considerable amounts of time waiting for multimedia files to download.

The CD ROM remains one of the most common ways of delivering multimedia training, largely because CDs have the capacity to store large multimedia files. Depending on the speed of the PC processor, the amount of RAM, and the speed of the CD ROM drive, users running a course from a CD ROM will not have their training interrupted by downloading media, nor will they have media "break up" during delivery.

The down side of using CD ROM as a delivery medium is the fact that if updates need to be made to a course, a new CD must be burned and given to each user. Multimedia courses typically run the best from a PC hard drive. That is, graphics come up quickly, and audio and video play smoothly. The only real question is one of storage space. Since one can write to a hard drive again and again, courses residing there can be updated as often as needed. In addition, if the PCs are connected to a local area network (LAN) or wide area network (WAN), course updates can be downloaded from a central location.

Most company local area networks (LANs) and wide area networks (WANs) are not equipped to store and deliver multimedia-again, because of bandwidth limitations. If a company already has, or is willing to invest in, a high-speed LAN, it is possible to deliver multimedia over a network. This is, at least for the next couple years, an expensive way to go. There are many hybrids strategies that are in use today. One of the most common is the one in which the course is run from individual workstations and student enrollment and performance data is communicated across the network. In this scenario, audio and video run smoothly, and, for courses running from the hard drive, updates come from a central location on the server.

The hybrid solution is an attractive option to many because they can get both updatability, together with the appeal of high-impact graphics, audio, and video. In order to evaluate the various delivery options, it was important to develop criteria on which to base the evaluation. Since this was to be The Times' first-ever technology training initiative, and because of the initial cost involved, it was important that the training be effective, appealing, and that it deliver a significant return on investment. Second, it was important that the training be *accessible to* users. Finally, it was important that the course be easily *updated,* because the content changed regularly. Because not all delivery systems can deliver all types of media with equal effectiveness, we will first discuss how to determine the type of media needed for a training course.

Next, we will discuss the accessibility of a course to the users. Finally, we will discuss issues related to the life-cycle maintenance of a course. In order to decide which types of media were to be used in the LA Times course, each of the following was carefully considered: 1) The audience, 2) Types of infor-mation to be communicated, and 3) How the information will be used.

In the case of the Los Angeles Times, the audience for the course includes the primary target audience, as well as various secondary audiences. While marketers had no previous experience with multimedia training, they were used to training that was both informative and entertaining. Trainers and managers expected training that would produce measurable results, and upper management expected training that would yield significant business results. It seemed that the best way to meet these expectations was to incorporate text, audio, graphics, video, and animation in the course. Different types of information are often best communicated through different types of media assets. On the other hand, if demonstrations or examples need to be given, graphics, audio, and/or video might more effectively communicate the message.

The information included in The Times' course included a large amount of examples, including customer objections and various responses to those objections. For these reasons, richer assets such as high-definition graphics and audio were found to be critical. One of the most important things to consider is how information in the multimedia title will be used. For example, will the course be used to help the user *reference* information, or *remember* information? Courses that help the user *remember* information usually require a higher level of interactivity. These types of activities often contain richer media, including graphics, audio, and video files. On the other hand, courses designed to help the user *reference* information often do not require the use of complex, media-rich activities.

One of the most common reasons companies choose interactive multimedia in the first place is because it can make training more accessible to learners than does classroom training. For example, a CD ROM can be taken anywhere a user has access to a multimedia-capable PC with a CD ROM drive. Likewise, a user can log in to an internet, intranet, or LAN-based course, anywhere they have access to the internet, intranet, or LAN. On the other hand, if they can't get to the internet, an internet-based course isn't going to work. Nor will a CD ROM based course work for those with no CD drives in their computers. Of course, hardware and infrastructure can be installed, but such installations usually impact timeline, budget, or both.

While a company intranet was in the piloting stages at The Times, none yet existed. Since the marketers work together in a central location, the use of multimedia computers in the adjoining training room became the logical choice. The term "Life-cycle maintenance" refers to how easy a course is to update, and how often updates need to be done to keep the course current. Because some delivery methods make it is easier than others to update a course, it is important to determine the life cycle maintenance of that course before selecting a delivery method. In the case of The Times, the course would be updated by individuals new to multimedia, so it needed to be relatively simple to do. In addition, course content changed as often as quarterly, so changes would need to be done fairly regularly.

After considering each of the options and after having developed criteria from which to base an evaluation, The Times selected a delivery system. Based on the expectations of the users, the type of information to be delivered, and the manner in which the information was to be used, it was determined that media for the course would include of text, graphics, audio, and video. This effectively eliminated the internet and LAN as delivery options, at least until such time as bandwidth problems was overcome. While a company intranet still holds the possibility of delivering the course to the largest numbers of people, it remains to be seen whether or not it will support the kind of media chosen for the course.

It is also unknown when the company intranet will be implemented, and if members of the target audience for the course will have access to it. Because the course will need to be updated regularly, a CD ROM delivery was eliminated as an option. Since the course would be updated by those new to multimedia, the course was created in templates, in Quest Net+. Not surprisingly, the delivery method chosen for this course was a hybrid hard drive/LAN delivery, in which the course is stored and played from individual PCs, and student enrollment data and test results are uploaded to a central location on the LAN server. Course changes are made in one location on the server. Course updates are then downloaded automatically from that location to individual PCs, as needed. Since the program was created in guest Net+, the course is already internetenabled, and can be delivered over the internet or company intranet as soon as bandwidth limitations are overcome.

A computer network is basically a bunch of computers hooked together somehow. In concept, it's sort of like a radio or TV network that connects a bunch of radio or TV stations so that they can share the latest episode of "The X-Files." Don't take the analogy too far. TV networks send the same information to all the stations at the same time (it's called broadcast networking); in computer networks, each particular message is usually routed to a particular computer. Unlike TV networks, computer networks are invariably two-way, so that when computer A sends a message to computer B, B can send a reply back to A. Some computer networks consist of a central computer and a bunch of remote stations that report to it (a central airline-reservation computer, for example, with thousands of screens and keyboards in airports and travel agencies).

Others, including the Internet, are more egalitarian and permit any computer on the network to communicate with any other. The Internet isn't really a network it's a network of networks, all freely exchanging information.' The networks range from the big and formal (such as the corporate networks at AT&T Digital Equipment, and Hewlett-Packard) to the small and informal (such as the one in John's back bedroom, with a couple of old PCs bought through the Want Advertiser) and everything in between. With networks, size counts for a great deal because the larger a network is, the more stuff it has to offer. Because the Internet is the world's largest computer network, it has an amazing array of information to offer. The Internet is new communications technology that is affecting our lives a scale as significant as the telephone and television. Some people believe that when it comes to disseminating information, the Internet is the most significant invention since the printing press. If you use a telephone, write letters, read a newspaper or magazine, or do business or any kind of research, the Internet can radically alter your entire world view.

When people talk about the Internet today, they're usually talking about what they can do and whom they have met. The Internet's capabilities are so expansive that we don't have room to give a complete list here (indeed, would fill several books larger than this one), but here's a quick summary:

Electronic mail (e-mail) is certainly the most widely used-you can exchange e-mail with millions of people all over the world. People use e-mail for anything they might use paper mail or the telephone for: gossip, recipes, rumors, love letters-you name it. (We hear that some people even use it for stuff related to work.) Electronic mailing lists enable you to join in group discussions with people who have similar interests and meet people over the Net. Mail servers (programs that respond to e-mail messages automatically) let you retrieve all sorts of information.

When people talk these days about surfing the Net, they often mean checking out sites on this (buzzword alert) multimedia hyperlinked database that spans the globe. The Web, unlike earlier Net services, combines text, pictures, sound, and even animation, and it lets you move around with a click of your computer mouse. New Web sites are growing faster than you can say "Big Mac with cheese," with new sites appearing every minute. In 1993 when we wrote the first edition of this book, the Internet had 130 Web sites. Today it has more than 600,000 and statistics indicate that the number is doubling every two months. The software used to navigate the Web is known as a browser. The most popular browsers today are Netscape Navigator and Microsoft Internet Explorer.

Many computers have files of information that are free the taking. The files range from U.S. Supreme Court decisions and library card catalogs to the text of old books, digitized pictures (nearly all of them suitable for family audiences), and an enormous variety of software, from games to operating systems. Special tools known as search engines, directories, and indices help you find information on the Net. Lots of people are trying to make the fastest, smartest search engine and the most complete Net index. We tell you about two of the most useful, Alta Vista and Yahoo! so that you get the picture. As mentioned in the introduction to this book, you see a Web icon here and there; it points to resources you can retrieve from the Net yourself.

Electronic commerce is just a fancy word for buying and selling stuff over the Net. It seems that everybody's doing it, and now the software is available to make sending your credit card number over the Net safe and secure. You can buy anything from books to stock in microbreweries.

A system called *Usenet* is an enormous, distributed, online bulletin board with about 700 million characters of messages in more than 20,000 different topic groups flowing daily. Online bulletin boards date from the 1970s-they're systems set up for people of like interests for discussion via e-mail, message areas, and real-time chat. Although most independent, non-Internet-connected bulletin board systems have been replaced by the Internet, the boffo bulletin board of all time, Usenet, is alive and well and is integral to the Internet. Topics range from nerdy computer stuff to hobbies such as cycling and knitting to endless political arguments to just plain silliness. The most widely read Usenet newsgroup is one that features selected jokes, most of which are pretty funny.

A game called MUD (Multi-User-Dimension or Multi-User Dungeon) can easily absorb all you waking hours. In it, you can challenge other players who can be anywhere in the world. Internet Relay Chat (IRC) is a party line over which you can have more or less interesting conversations with other people all over the place Although Irc seems to be frequented primarily by bored college students, you never know whom you will encounter. Many Internet providers have facilities for "chatting" that enable you to have online conversations with a bunch of people at the same time. In the 1960s scientists in USA started experimenting on direct connection of remote computers.

The government decided to finance the project and use it for military purposes. During cold war time the US military wanted to come up with a system that would be reliable even in war time. Three mainframe computers in California and one in Utah were interconnected forming the DARPANET (later known as ARPANET). In this Arpanet model, communication always occurs between a source an ' the destination computers assuming that the network itself is unreliable (typical military philosophy). Hence the communication must occur with minimum information from server/client computers. The message data is put into an envelope (called IP packet) and addressed correctly. This was the original thought while the Internet Protocol (mutually agreed upon method of communication between parties) was designed.

Although the Organization for International Standards (ISO) was spending years designing ultimate communication standards, the computing community could not wait! The IP protocol became de-facto and people started implementing it on different platforms. This grew exponentially and later down the time even the universities were also allowed to hook up to this net. The volume of work grew so fast that the military traffic had to be shifted to a separate network called MILNET. Procedures were set up to regulate the allocation of addresses and to create voluntary standards for the network. Some non-IP based local area networks became more pervasive and many hosts became gateways to local networks. Thus non-IP based networks also became Internet users.

A network layer to allow the interoperation of these networks was developed through Internet Protocol (IP). Over the time other groups created long haul IP based networks (NASA, NSF, states ...) These nets, too, interoperate because of Internet protocols. The collection of all of these interoperating networks is the Internet. The commercial use of the Internet was also permitted before some time. In India it started from August 1995. And as of today, anyone (with a desire to communicate and as little as Rs. 5000 or Rs. 500 for students) can be on the Internet! The organization structure of Internet is as complex as the rest of it! The ultimate authority of Internet is the Internet Society (ISOC).

The ISOC is a voluntary membership organization whose purpose is to promote global information exchange through Internet. It appoints a council of elder members called Internet Architecture Board IAB) which is responsible for technical management. Thanks to Iab the Internet is not Vendor specific or Platform stuck. Another voluntary organization that is less technical in nature is the Internet Engineering Task Force IETF).

Internet is a network of networks. From a tiny number of 4 mainframes in 1960 the number has (out) grown to more than 40,000 networks, 200 countries and 100 million users. With the growth rate of 6000% p.a. it surely is, as Bill Gates quotes, "The Road Ahead". A few groups provide much of the information services on the Internet. Information Sciences Institute ISI) does much of the standardization and allocation work of the Internet acting as the Internet Assigned Numbers Authority (IANA). Sri International provides the principle Information services for the Internet by operating the Network Information Center (NIC).

Today's Internet is a network having PCs, Minis, Mainframes and Super-computers sharing information with each other. The touch of Internet could be felt in a variety of flavors which can be broadly classified into three classes. Access through Gateway type connection is the poormen's connection to the Internet. It's like access to the Internet without being on it. Imagine a small network or BBS that has nothing to do with Internet as such. But as one of the computers on this network gets the Internet access, all the remaining computers on the network get hooked up to it. Thus this intersection point computer provides a gateway to Internet access for the rest of the network. The' advantages of this gateway style connectivity are:

— The low cost of access as the cost is shared by the whole network.

- Even the existing non-IP based networks can be easily connected.

The disadvantages are:

- You are not really on the Internet. Means the network depends on the facilities provided by the gateway.

AOL (America On-Line), CompuServe, Prodigy and even VSNL GIAS are examples of gateway connectivity. Many of the gateways provide access to only E-mail service of the Internet. Some others provide many other services as well. Currently in India, VSNL Gateway is providing E-mail, FTP, Telnet, Chat, Kermit, Zmodem upload/download and UNIX prompt facilities to its subscribers. Remote Access Connectivity is achieved through a dial up terminal connection.

The mainframe on the Internet is used as a host using a dial up connection. The host carries out commands typed at terminal. This is the most widely used type of Internet connectivity. The problem associated with this level is that only the programs present at the host can be executed. Loading a new program or client does not provide the ability to execute it. Similarly downloading a file from any site becomes a two step process. Downloading from the site to host and then transferring from host to local terminal. This highest and most expensive type of connectivity is achieved by high speed lines to go online on the Internet. Internet is available round the clock. It is usually opted with heavy load and a number of users using a mainframe computer.

A new class of connectivity that is now coming into existence is the On-Demand Direct connectivity. The direct connection is provided on demand by the service providers based on Point to Point Protocol (PPP) or the Serial Line Internet Protocol (SLIP). It costs very less and still gives the power of direct connection. But Direct connectivity and Remote access connectivity are too expensive to be discussed here. Besides, it is most unlikely that you might come across anything except gateway connectivity, so we shall stick to it.

From 15th August 1995 onwards Gateway Internet access is possible in India through VSNL. Yes this is true in a broader sense but then India is a big country! Hundreds of cities of India and other countries do not have local connectivity and probably will have to wait for years before they have it. With e-mail company here not having put up a good show, it is least likely anybody will go in for investment to provide Internet access for a long time. Similar is the case in most small cities. Does this mean millions of geographically unlucky people in these cities will have to be deprived of such a wonderful magic link.

Presenting a virtual kind of Internet connectivity for which you require only E-mail and a little knowledge. The section of this book "Internet Access by e-mail" describes how you can access almost any resource using E-mail as your only weapon. You can Access WWW, Gopher, Ftp, Usenet, Archie and much more if you have E-mail at your disposal. This is not only useful for these geo-unlucky people who cannot get hooked to Internet but also for those who are already hooked-on because when you go online your meter starts ticking.

A TCP/IP account today costs hourly Rs. 30 for individuals to Rs.50, for companies (plus STD or INET charges if you are geo-unlucky). The line conditions in India leave you trapped in statue pOSItion for unbearable time making it not only boring but also costly to access resources. These simple tricks can help you surf offline and save money, your time and connectivity time.

You can arrange a talk "in real time" with your client in Tokyo (Japan) and two of his financiers one in

Boston (US) and other in Kingston (Australia); read a book from Drexel University library (Philadelphia, US) and then go to Singapore to book a room in a hotel on the Orchid street and send a small video clip of your new pet dog (Jimmy) to your uncle living some 300 km away from your house; conduct an interview of a head of the business house of Sri Lanka asking him how tough are business conditions in his country and listen to some latest soundtracks released in Africa last weekend and all this in a matter of some 45 minutes and not at the cost of a fortune. Your house is locked and every one is gone for a tour. A visitor comes home and pushes the doorbell button! Ting-Tong. The doorbell is connected to your desktop which, by Internet, is connected to you. You are in a taxi heading for a business meeting in other country. The cellular phone rings and your laptop picks it up for you. You talk to the visitor. Oh! you had a date. Damn it you forgot.

Anyway now let her In. So you press that access code and the door of your house unlocks and then you put on the TV change channel to 4. talk to her (mainly saying sorry you see I had ....) and as she leaves lock the door turn the TV off and.... well the only thing which is unusual about this fiction is that it isn't! This is a reality that's not too far away. A survey in January 1996 shows that the number of host computers (a computer which has it's own numerical Internet address, the doted quard) has Zoomed up to 9,472,000 exhibiting an annual growth rate of 85%. The growth of domain names surpasses the growth of hosts putting the number to 2,40,000. The country wise breakup of host computers is as under:

Germany (de)	4,52,997	Netherlands (nl)	1,74,888
UK (uk)	4,51,750	Sweden (se)	1,49,877
Canada (ca)	3,72,891	France (fr)	1,37,217

Australia (au)	3,09,562	US (us)	2,33,912
Japan (jp)	2,69,327	Finland (fi)	2,08,502

Israel witnessed a phenomenal growth in claiming its Internet presence during the later half of the 1995. Other countries that had a similar trend of growth were Singapore, Italy, France, Japan and Taiwan. More than 35 countries got hooked up to the Internet by registering a host for the first time during the same period.

Today there are more than 40,000 networks, 200 countries and 100 million total users on the net and the number is growing at 10% every month! Macs, IBM PCs, Minis, Mainframes and super computers' running all different operating systems. The biggest problem one is likely to face when first using the 'net is similar to being lost in a new city. You don't know where to find things. Even the experienced internauts find themselves surprised when they discover a new possibility they'd never known even existed.

A basic difference between the postal service and E-mail is that E-mail gives you a feeling that it's not merely your message that reaches the destination but you who reaches out. It is rightly called the DEATH OF DISTANCE. Reaching where you want to go can often be one of the most difficult aspects of using any networks.

Each country also has its own top-level domain. For example, the U.S. domain includes each of the fifty states belonging to the USA. Other countries represented with domains include:.

au	Australia
jp	Japan
ca	Canada
se	Sweden

fr	France
fi	Finland
in	India
sg	Singapore
su	Soviet Union (one place where it still exists)
uk	The United Kingdom.

These also have sub-domains of things like 'ac.uk' for academic sites and 'co.uk' for commercial ones.

Every single machine on the Internet has a unique address, called its Internet number or IP Address. It's actually a 32-bit number, but is most commonly represented as four numbers joined by periods C.'), like 202.54.1.18. This is also called a dotted quad; there are literally thousands of different possible dotted quads. The ARPAnet 9the mother of today's Internet) originally only had the capacity to have up to 256 systems on it because of the way each system was addressed.

In the early eighties, it became clear that things would fast outgrow such a small limit; the 32-bit addressing method was born, feeling thousands of host numbers. Each piece of an Internet address (like 202) is called an "octet," representing one of four sets of eight bits. The first two or three pieces (e.g. 202.54.1) represent the network that a system is on, called its subnet. For example, all of the computers for Wesleyan University are in the subnet 129.133. They can have numbers like 129.133.10.10, 129.133.230.19, up to 65 thousand possible combinations (possible computers). Fortunately enough the IP addresses and domain names aren't assigned arbitrarily-that would lead to unbelievable confusion.

Ok, computers can be referred to by either their Fully Qualified Domain Names (FQDN) or their Internet address. Fortunately No. The Internet is designed so that one can use either method. Since humans find it much more natural to deal with words than numbers in most cases, the FQDN for each host is mapped to its Internet number. Each domain is served by a computer within that domain, which provides all of the necessary information to go from a domain name to an IP address, and vice-versa. For example, when someone refers to giasbm0l. vsnl.net. in starting from right we get.in means it's in India, VSNL stands for Videsh Sanchar Nigam Limited and GIAS for Gateway Internet Access Service, BM for Mumbai server. So referring to giasbm0l. vsnl.net in tells the computer that we are looking for GIAS of VSNL at Mumbai in India. Going by the numbers it would have been 202.54.1.18. All of this boring stuff happens where it should, behind the scenes.

Seventh-grade students in San Diego use the Internet to exchange letters and stories with kids in Israel. Partly it's just for fun and to make friends in a foreign country, but a sober academic study reported that when kids have a real audience for their stuff, they write better. In some parts of the world, the Internet is the fastest and most reliable way to move information.

During the 1991 Soviet coup, a tiny Internet provider called RELCOM, which had a link to Finland and through there to the rest of the Internet world, found itself as the only reliable path to get reports in and out of Moscow because telephones were shut off and newspapers weren't being published. RELCOM members sent out stories that would have been in newspapers, statements from Boris Yeltsin, and their personal observations from downtown Moscow.

Medical researchers around the world use the Internet to maintain databases of rapidly changing data. People with medical conditions use the Internet to communicate with each other in support groups and to compare experiences. The Internet is its own best source of software. Whenever we hear about a new service, it usually takes only a few minutes to find software for our computers (various computers running various versions of Windows and a Macintosh Power PC), download it, and start it up. Nearly all the software available on the Internet is free.

The Internet has local and regional parts as well. When John wanted to sell a trusty but tired minivan, a note on the Internet in a local for-sale area found a buyer within two days. Margy's husband sold his used computer within half an hour of posting a message on the relevant Usenet newsgroup. The Internet is unlike all the other communications media we have ever encountered. People of all ages, colors, creeds, and countries freely share ideas, stories, data, opinions and products.

One great thing about the Internet is that it's probably the most open network in the world. Thousands of computers provide facilities that area available to anyone who has Net access. This situation is unusual-most networks are very restrictive in what they allow users to do and require specific arrangements and passwords for each service.

Although pay services exist (and more are added every day), many Internet services are free for the taking. If you don't already have access to the Internet through your company, your school, or a friend's attic, you probably have to pay for access by using one of the Internet access providers. Another great thing about the Internet is that it is what one might call "socially unstratified." That is, one computer is no better than any other, and no person is any better that any other. Who you are on the Internet depends solely on how you present yourself through your keyboard. If what you say makes you sound like an intelligent, interesting person, that's who you are. It doesn't matter how old you are or what you look like or whether you're a student, a business executive, or a construct ' ion worker. Physical disabilities don't matter-we correspond with people who are blind or deaf. If they hadn't felt like telling us, we never would have known. People become famous in the Net community, some favorably and some unfavourably, but they get that way through their own efforts. Here are some of the things people use the Internet for:

If you have lost track of your childhood sweetheart, now's your chance to find him or her anywhere in the country. You can use one of the directory services to search the phone books of the entire United States.

New Yellow Page directory services enable you to search by the type of company you're looking for. You can indicate area code or zip code to help specify the location. People are shopping for that hard-to-find special gift item. A friend told us of her search for a bear pendant that took her to a company in Alaska that had just what she was looking for.

Law firms are finding that a great deal of information they formerly paid $600 an hour to find from commercial services can be found for close to nothing when they go directly to the Net. Real estate appraisers use demographic data available on the Net, including unemployment statistics, to help assess property values. Genetics researchers and other scientists download up-to-date research results from around the world. Businesses and potential businesses research their competition over the Net.

School teachers coordinate projects with classroom all over the globe. College students and their families exchange e-mail to facilitate letter writing and keep the cost of phone calls down. Students do research from their home computer. The latest encyclopedias are online.

Cities, towns, states, and countries are using the Web to put up tourist and event information. Travelers find weather information, maps, transportation schedules, and museum hours online.

Software companies are selling software and providing updates via the Net. (The folks making money from the manufacture of floppy disks are looking for new products. Aside from the large pile of AOL disks we now use as coasters, most software distribution is migrating to the Net.) Companies are selling products over the Net. Online bookstores and music stores allow people to browse online, choose titles, and pay for stuff over the Net.

People are finding romance on the Net. Singles ads and match making sites vie for users. Contrary to Internet lore, the Net community is no longer just a bunch of socially challenged white men under 25.

Patients and doctors keep up-to-date with the latest medical findings, share treatment experience, and give one another support around medical problems. We even know of some exceptional practitioners who exchange e-mail directly with their patients.

People buy stock and invest money. Some companies are online and trade their own shares. Investors are finding new ventures, and new ventures are finding capital.

Conference and trade-show organizers are finding that the best way to disseminate information, call for papers, and do registration is to do it on the Web. Information can be updated regularly, and paper and shipping costs are dramatically reduced. Registering online saves on-site registration staff and on-site registration lines.

Churches, synagogues, and other community organizations put up pages telling about themselves and inviting new people. The earth-shattering, startling new idea of how to buy things over the Net lies buried in the inner meaning of the following phrase: "Enter your credit card number." We're not saying that you shouldn't exercise caution, but our experience of buying stuff over the Net in the past year tells us that you have no great cause for alarm. What have we bought? Books, Cds, clothing, encyclopedia subscriptions, and matchmaking subscri-ption. Here's what you need to know. Some folks seem particularly wary of sending their credit card number over the Net. If you use a credit card at all, remember that the credit card companies are even more concerned than you are about the idea of any kind of credit card fraud, on or off the Net.

All cards have a limit on the amount of fraudulent use for which you're liable with many credit cards, you're not responsible for any charges resulting from your card or card number being stolen-and the most they can hold you responsible for, if you're a U.S. resident, is $50. Any fraud higher than that amount is the card company's problem, not yours. Despite all the foofaraw (a technical term) about the risks of online credit card use, we haven't found one single case of a card number being stolen in transit over the Internet.

On the other hand, every day we hand our actual physical cards with our handwritten signature to gas station attendants wearing distinctive outfits in bright colors not found in nature, to servers at restaurants, and to clerks at all sorts of stores. Do you know what they do with the card before they give it, back to you? Do you worry about it? We don't. The point is, if you're comfortable using a credit card at all, you needn't get really scared about using it over the Net just because it seems new.

To avoid the possibility of bad guys or gals electronically listening to the bits of your private information whirring across the Net, stripping them off, and redirecting them to purchase their dream vacation, schemes have been invented to encode info sent over the Net so that even if the villains intercept the info, it won't do them any good-it gets all mixed up and hidden in such a way that only the legitimate recipient can decode it. The software that processes this information safely, hiding everything from possible perverse perusal, is known as a secure server.

Many Web browsers have secure servers built right in. If you're the least bit antsy about sending your card number over the Net, stick to secure servers. Software that takes your credit card number (or any other information) over the Net without encoding it is known as an insecure server. Insecure servers are perfectly adequate for many transactions and shouldn't be shunned automatically. Think about the information that's being requested and whether you think that the risk of fraud is a problem. If you do, hold out for a secure server or find another way (such as using the phone) to carry out the business you need to do.

The Internet's funny place. In some ways it's completely anonymous and in others not at all. In the good olde days, people usually had Internet user names that bore some resemblance to their true identity-their name or initials or some combination in conjunction with their university or corporation gave a fairly traceable route to an actual person. Today, with the phenomenon of screen names (courtesy of America Online) and lengthy strings of numbers (courtesy of CompuServe), revealing your identity is, at best, optional. Depending on who you are and what you want to do on the Net, you might, in fact, want different names and different accounts. Here are some legitimate reasons for wanting them: You're a professional-a physician, for example and you want to participate in a mailing list or newsgroup without being asked for your professional opinion.

You want help with an area of concern that you feel is private and would not want your problem known to people close to you who might find out if your name were associated with it. You do business on the Net, and you socialize on the Net as well. You might want to keep those activities separate.

The whole anonymous nature of the Internet has its downside as well. Although it's relatively rare, horrible things have happened to a few people who have taken their Internet encounters into real life. Many wonderful things have happened too. We have met some of our best friends over the Net, and some people have met and gotten married-no kidding! We just want to encourage you to use common sense when you set up a meeting with a Net friend. Here are a few tips: Talk to the person on the phone before you agree to meet. If you don't like the sound of the person's voice or something makes you feel nervous, don't do it.

Depending on the context, try to check the person out a little. If you have met in a newsgroup or chat room, ask someone else you know whether they know this person. (Women, ask another woman before meeting a man.) Meet in a well-lit public place. Let someone else know where you're going. If you're a kid, take a parent with you. If you're not a kid but you're a little nervous, bring along a friend.

The Net is a wonderful place, and meeting new people and making new friends is one of its big attractions. We just want to make sure that you're being careful. In the United States, people grown up with certain attitudes about freedom and privacy, many of which we take for granted. They tend to feel that who they are, where they go, and what they do is their own business as long as they don't bother anyone else. Well, it would seem that a whole bunch of people are very interested in who they are, where they go (on the Net, at least), and, most especially, what they buy. All this interest is being sanctioned in the name of that ever-so-altruistic-keeping-only-our-best-interests-in-mind holy being Marketing. We tell you this in case you're sensitive about data being collected about your personal Net habits.

The next two sections tell you what's happening. To enhance your online experience, the makers of Web browsers, such as Navigator and Internet Explorer, have invented a type of special message that lets a Web site keep track of when you have visited that site. They thoughtfully store this info, called a *cookie,* on your very own machine to make your next visit to the same site smoother. This info can in fact make your next transaction smoother, but it can also cause you some problems. Many cookies are quite handy. When you're using an airline-reservation site, for example, the site uses cookies to keep the flights you're reserving separate from the ones other users might be reserving at the same time.

On the other hand, suppose that you use your credit card to purchase something on a Web site and the site uses a cookie to remember your credit card number. Suppose that you did this from a computer at work and the next person to visit that site used the same computer. They could, possible, make purchases on your credit card. If may be true that cookies can make your life more convenient. You have to be the judge of that.

Every Web server can offer you cookies. You need to know that this kind of software exists so that if you are concerned about your privacy, you can take steps to protect it. Cookie files usually have the name cookie associated with them-cookies.txt and Magic Cookie, for example. You can delete your cookie files-your browsers will create a new, empty one.

Modern browsers can tell you about cookies and ask you whether to accept them as servers offer them to you. When Carol checked her Macintosh, she found two cookie files-one from Navigator and one from Internet Explorer. If she hadn't been looking for them, she never would have known that they were there. Cookie files cannot get other information from your hard disk. They only collect information that the browser tells them about.

As a general rule, we all need to be on the lookout for programs we install that do a little more than advertised. Internet Explorer keeps, in addition to the cookie file, a history file of where you have been on the Web. (Look in your Internet Explorer folder for something called History.html.) If anyone other than you uses your computer, you might want to delete this file after your use, unless you don't care who sees if. Courts have ruled, by the way, that companies own their computers and their contents. You have no "right to privacy" at work, even though most of us find the idea creepy. Companies can eavesdrop on phone calls, read you e-mail (going and coming) and read anything that's on your computer, including a history file detailing where you have searched. We find this tasteless and disturbing, so we think we ought to warn you.

The Internet is not so private a place as you might think. While we're sitting in our homes typing on a keyboard, we hardly get the sense that someone could be watching our every move. Yet information gets relayed from machine to machine, and along the way, if someone really cares, she or he might be able to take a look at what comes across the wire. Whether you're sending your credit card number or sending e-mail, you might feel more comfortable if the absolute secure nature of the transmission were guaranteed. You can guarantee security using encryption. Encryption is high-tech-ese for encoding-just like with a secret decoder ring. You know-codes, spies, secret messages.

Software exists that helps you package up your message and send it in a way that nobody can read it except the intended recipient. Some folks say that sending e-mail that's not encrypted is equivalent to sending your message on a postcard. Encryption is the virtual envelope that defies prying eyes. In practice, we rarely encrypt e-mail, though we're happy to know that the option exists. One reason we don't is that at this point it's too darned cumbersome. When e-mail software comes with encryption built-in, many more people will choose to use it. In the meantime, if you feel that you need it, you can learn about PGP, which stands for Pretty Good Privacy. Because it's complicated enough to require pages of explanation, we don't have room in this book to go into the details. New, easier-to-use versions of PGP come out every month or two, so by the time you read this chapter, a PGP add-in may well be available for your favorite mail program.

The ancestor of the Internet was the ARPANET, a project funded by the Department of Defense (DOD) in 1969, both as an experiments in reliable networking and to link DOD and military research contractors, including the large number of universities doing military funded research. (ARPA stands for Advanced Research Projects Administration, the branch of Defense in charge of handing out grant money.

For enhanced confusion, the agency is now known as DARPA-the added D is for Defense, in case there was any doubt where the money was coming from.) The

ARPANET started small, connecting three computers in California with one in Utah, but it quickly grew to span the continent. The reliable networking part involved *dynamic routing.* If one of the network links became disrupted by enemy attack, the traffic on it could be rerouted automatically to other links. Fortunately, the Net rarely has come under enemy attack. Cutting a cable during road construction (known in the biz as *backhoe fade) is* just as much of a threat, however, so it's important for the Net to be backhoe resistant.

Because the ARPANET was wildly successful, every university in the country wanted to sign up. This success meant that the ARPANET began getting difficult to manage, particularly with the large and growing number of university sites on it. It was broken into two parts:

— MILNET, which had the military sites
— The new, smaller ARPANET which had the nonmilitary sites

The two networks remained connected, however, thanks to a technical scheme called IP (Internet Protocol), which enabled traffic to be routed from one network to another as necessary. Because all the networks connected in the Internet speak IP, they all can exchange messages. Although there were only two networks at that time, IP was designed to allow for tens of thousands of networks.

An unusual fact about the IP design is that every computer on an IP network is, in principle, just as capable as any other, so any machine can communicate with any other machine. Beginning around 1980, university computing was moving from a small number of large timesharing machine, each of which served hundreds of simultaneous users, to a large number of smaller desktop workstations for individual users. Because users had gotten used to the advantages of timesharing systems, such as shared directories of files and e-mail, they wanted to keep those same facilities on their workstations. (They were perfectly happy to leave behind the disadvantages of time-shared systems. A sage once said, "The best thing about a workstation is that it's no faster in the middle of the night.")

Most of the new workstations ran a variety of UNIX, a popular (and, for many versions, free or close to it) type of operating software that had been developed at AT&T and the University of California at Berkeley. The people at Berkeley had a government contract to improve computer networking, so their version of UNIX included all the software necessary to hook up to a network. Because workstation manufacturers also began to include the necessary network hardware, all you had to do to get a working network was to string the cable to connect the workstation, something that universities could do for cheap because they usually could get students to do it. Then, rather than have one or two computers to attach to the ARPANET, a site would have hundreds. What's more, because each workstation was considerably faster than an entire 1970s multiuser system, one workstation could generate enough network traffic to swamp the ARPANET, which was getting creakier by the minute.

The next event was that the National Science Foundation (NSF) decided to set up five supercomputer centers for research use. The NSF figured that it would fund a few supercomputers, let researchers from all over the country use the ARPANET to send their programs to be "super computed," and then send back the results. The plan to use the ARPANET didn't work out for a variety of reasons some technical, some political. So the NSF, never shy about establishing a new political empire, built its own, much faster' network to connect the supercomputing centers: the NSFNET. Then it arranged to set up a bunch of regional networks to connect the users in each region, with the NSFNET connecting all the regional networks. The NSFNET worked like a charm. By 1990, if fact, so much business had moved from them ARPANET to the NSFNET that, after nearly 20 years, the ARPANET had outlived its usefulness and was shut down.

The super computer centers the NSFNET was supposed to support turned out to be a fizzle: Some of the supercomputers didn't work, and the ones that did were so expensive to use that most potential customers decided that a few high performance workstations would do just as well. Fortunately, by the time the supercomputers were on their way out, the NSFNET had become so entrenched in the Internet that it lived on without its original purpose. By 1994, several large, commercial Internet networks had grown up within the Internet, some run by large, familiar organizations such as IBM and Sprint and others run by such specialist Internet companies as PSI and Alternet.

The NSFNET has been wound down, with its traffic taken over by commercial networks. Although the NSFNET permitted traffic related only to research and education, the independent, commercial IP network services can be used for any legal purpose. The commercial networks connect to the regional networks just as the NSFNET did, and they provide direct connections for customers. Outside the United States, IP networks have appeared in many countries, either sponsored by the local telephone company (which is usually also the local post office) or run by independent national or regional providers.

The first international connections were in 1973 with England and Norway. Nearly all countries are connected directly or indirectly to some U.S. network meaning that they all can exchange traffic with each other. The term Internet first appeared in 1982 with the DARPA launch of the Internet Protocol.

To connect to the Internet, you have two major choices-or three, if you're lucky:

— *Sign up with an online service, such as America Online or CompuServe.* Online services tend to be easier to use, and they provide information in a more organized way. They usually don't give you the full range of Internet services, however. Unless services have a flat rate for unlimited use, they can be expensive if you use them for more than a few hours a month. Because the demand is growing faster than some providers are able to support, access is sometimes slow.

— *Sign up with an Internet provider for, an Internet account.* These days, most providers provide you with a PPP or SLIP account. Most still also provide that we will explain them again in a few paragraphs). Most still also provide UNIX shell accounts or both shell and PPP accounts. You need PPP or SLIP to use all the cool, new programs, such as Netscape Navigator, Microsoft Internet Explorer, and Eudora.

— *Sign up for, cable access.* We say "if you're lucky" because cable access is not widely available yet. It it is, however, all you have to do is call your cable company and arrange for them to come and install a network card in your computer and some cable to your home (if you don't already have cable TV). If you choose this option, you can skip the rest of this chapter and the next two chapters and just gloat. You don't need a phone, you don't need a modem, and you don't need a TV.

We had better explain what PPP and SLIP are. Here are the three incomprehensible acronyms you need to know:

— PPP (Point-to-Point Protocol): Enables your PC to connect to the Internet not as a terminal but as a full-fledged member of the Net, at least while your computer is on the phone to its Internet provider

— SLIP (Serial Line Internet Protocol): An older version of the same thing

— CSLIP (Compressed SLIP): A faster version of SLIP

Because these three protocols are identical for our purposes, we refer to them all as PPP. All three are versions of IP (Internet Protocol), the underlying part of TCP/IP (Transmission Control Protocol/Internet Protocol), which is they way that all computers on the Internet communicate with each other.

All three are cool because many network operations are much simpler when your own computer is on the Net instead of acting as a terminal to someone else's big computer-programs running on your own computer can do much nicer sound, graphics, and animation than a terminal can. To use a PP account, you need two types of programs:

— *A program to get you connected to the account:* The technical term for this type of program is a TCP/IP stack, although normal mortal human beings usually call it something like an Internet dialer program. If you use Windows, your Internet dialer program comes with a file called WINSOCK.DLL. Macintoshes have the basic TCP/IP stuff, called MacTCP, built in as of System 7. You also need MacPPP, MacSLIP, or InterSLIP to handle the telephone-dialing stuff. (New Macintoshes come with it already installed.)

— Programs to use various Internet services: These programs give you access to e-mail, the Web, and information over the Internet. They're known as client programs because they're part of a two-part strategy-part of the programs run on your computer; the other part, the server programs, run on your provider's computer.

You want an e-mail program to read and send e-mail,, a Web browser to surf the Web, and a newsreader program to read Usenet newsgroups. Or you can get a program that does all three, such as Netscape. If you use Windows, you can use any Winsock-compatible program (any program that works with the WINSOCK.DLL file that's part of your Internet dialer program). If you use a Mac, you can use any MacTCP-compatible program. All the cool Internet programs you have heard about are either WinSock-or MacTCP-compatible, and many work on both Windows and Macs. PPP connections are easy enough to use, but they can be tricky to set up. In fact, connecting can be the hardest part of your Internet experience.

Installing and setting up TCP/IP software requires entering lots of scary-looking numeric Internet addresses, host names, communications ports-you name it. Make sure that your provider is helpful and available, or choose another provider. If you have a friend or relative whom you can bribe or coerce into helping you, do so. Because each provider is just a tad different from the next, we can't go into exact step-by-step directions for everyone. We give the usual steps, help you understand the terms, and coax you through. If you find this process totally impossible and have no one you can press into service or just don't like the thought of doing this, don't despair. If you're Windows 95 user, in which we tell you where you can find detailed, step-by-step instructions. If you're not, consider using America Online or CompuServe to get started.

Hardware-wise, here's what you need to cruise the Net:

— *A modem that connects your computer to a phone line:* The faster the modem, the better. Try to get a modem that talks at 14.4 Kbps (bits per second), 28.8 Kbps, or even 33Kbps. Otherwise, things will be sluggish.

- *A phone line (you* probably guessed that): Make sure that your phone line doesn't have call waiting. If it does, you have to type 70 or 1170 at company to turn off call waiting for this phone call.
- *A computer capable or running Winsock-or MacTCP-compatible programs:* Any computer that can run Windows 3.1 or Windows 95 or any Macintosh will do fine. Note, however, that the World Wide Web is full of pictures that take up a large amount of hard disk space. To get the full effect, you probably want more than the minimal amount of memory that came with older machines, and you may need more disk space. Before you upgrade an older machine, look at the brand spanking new ones-they have changed a great deal in the past couple of years, and now may be the time to trade yours in.

To get your Windows PC set up for PPP, follow these steps:

1. Arrange for a PPP account from a local provider.
2. Get the basic TCP/IP software loaded into your computer somehow, either from a disk or over the phone.

Use the software your PPP provider gives you, if any, or get a friend to download it from the Internet for you and give it to you on a floppy disk. Some providers mail you a disk. Others start you off with a UNIX shell accounts that they tell you over the phone how to set up and then provide a program to download the rest of the software you need.

3. Type about a thousand setup parameters, if you're not lucky.

Your Internet provider (if it provided the software) or the software vendor should have given you instructions for when to type what. If you're lucky, your software has an automatic configuration program to set most or all of the setup parameters. In the section "Many mysterious numbers," later in this chapter, we tell you as much as we know about the parameters you might encounter.

4. Crank up your TCP/IP program, and fiddle with it until it works.

Hey, sometimes it works the first time. If it doesn't call and ask your provider to help you. You may find it difficult and frustrating if you have only one phone line, and you have to hand up to call your provider.

We can only sympathize and tell you that, yes, it's a real pain, it shouldn't be this difficult, and one day it won't be. For now, it is. When you use a menu-driven application (such as gopher) to find information, you are guided through the complexities of the Internet in an orderly way. At every step, a menu provides a neat picture of your current location and your choices for further action.

Many people find the "tree" metaphor useful for understanding menu-based systems: your search begins at the "root" menu and moves through various levels of branches until you finally arrive at the "leaf' level of the menu tree where you find the information you're after. If the information you retrieve through a menu-based system is incomplete, or if it raises new questions, you'll go back to the root menu and search through the menu tree again looking for something that addresses these new issues. In a conventional menu-based system, every search ends at the leaf level: the files to which the menus lead don't point to other resources that might be useful.

In the Internet community there are visionaries promoting a different way of organizing information, and this alternative view has become the fastest growing application on the Internet and a mainstream phenomenon. In place of a tree-shaped menu structure, imagine a "web," in which there are as few "dead ends" as possible. In this vision of how to structure information, even the files and documents you retrieve should be capable of pointing beyond themselves to other useful or related resources. The application that implements this vision on the Internet is the World Wide Web (also known as W3 WWW, or the Web). W3 was developed at CERN (European Centre for Nuclear Research), an institution for high-energy physics research in Geneva, Switzerland. Its original purpose was to promote the sharing of research materials and collaboration between physicists at many different locations.

W3 quickly developed an eager following outside the High-Energy Physics (Hep) community, and there are now more than 310OW3 servers worldwide. This count and some other statistics about W3's growth were done by Matthew Gray of Mit (mkgray@mit.edu). W3 is very strongly represented in Europe, and has recently caught on in North America. The Web has also begun to attract an audience outside the academic world. You'll find Web Servers for the Encyclopedia Britannica, the city of Palo Alto, Ca and the 1998 Winter Olympics. CERN has very generously made W3 available to this larger audience and continues to encourage the proliferation of servers.

W3 is a client/server application that is similar to gopher in many respects. Like gopher, W3 lets you retrieve information without having to know where on the Internet that information is stored. When you first use W3, it will probably seem a lot like gopher. At every step of the way, you'll have clearly identified choices presented to you in menus. Like gopher, W3 provides an interface to other Internet applications such as gopher, ftp, or WAIS (Wide Area Information Search). However, W3 has included a subject catalog from the outset, and even though the catalog is incomplete, it is a tremendous help in guiding the curious to resources of interest. W3 is also the only Internet application that is hypertext-based. Hypertext is what gives W3 its weblike character. Hypertext is a word first coined in the midsixties by Ted Nelson, the founder of the Xanadu Project, to describe texts that offer alternatives to sequential reading.

Today hypertext has come to signify electronically annotated documents that are linked to other documents (and potentially to graphics or to recorded sounds) than may help interpret or clarify the parent document. Imagine reading something and finding a word whose meaning you don't know. If you're reading plain text, you set it aside and look up the word in a dictionary. If you're reading hypertext, you select the unknown word to find any explanations that are lined to it.

The explanation may in turn have links to other documents as well. Pursuing the links from document to document can lead to topics and ideas that might not have occurred to you just from reading the original document. There is nothing about hypertext that forces it to be graphically sophisticated, and some of the hypertext resources you'll encounter on the Internet will be simple text files that happen to have links. You'll also encounter hypertext documents that are masterpieces of graphic design, and these give W3 its reputation as an application that is best enjoyed from a graphical interface.

The trail of hyperlinks isn't limited to documents alone. It can also lead to pictures or audio recordings. The word "hypermedia" has been coined to describe these annotated mixedmedia presentations. If your computer has graphics and sound capabilities (and if you're using the right W3 client), you'll get all the sights and sounds that have been programmed into W3 resources. If you system doesn't support these media, the

Web will deliver its resources to you as text only. Creating hypertext is labour-intensive. Ideally every word in a document could have links to other sources of information, and links between documents don't just happen. They are made ("built") using a hypertext editor that encodes text in a language capable of expressing the text's links to other documents. Some of the resources you'll encounter on W3 will be plain hypertext, and even the hypertext documents may not be as heavily linked as you would like.

The influence of hypertext is apparent throughout W3 , however. The underlying protocol used by W3 is the Hypertext transfer protocol (HTTP), and the Hypertext Markup Language (HTML) is used to produce and link documents. Working with W3, you'll see that the distinction between menus and documents or files becomes fuzzy, W3 menus tend to be wordy because they are actually documents. Documents, because they have links that lead to other resources, begin to take on a menu-like appearance. It's possible to build a collection of hypertext documents that don't use a network at all. In that case, all the linked documents must reside on the same computer.

The Web successfully combines hypertext with clients/server architecture. The startling thing about W3 is that it is a hypertext system in which the links from a document can point anywhere on the Internet. The interaction between W3 clients and servers resembles the gopher client/server dialog.

The client connects to a server long enough to submit one request and receive a reply. In W3, client requests take the form of URLs, Uniform Resource Locators. At first glance, Urls may look like gibberish. However, with a little practice at identifying fully qualified domain names and email addresses, you can learn to read URLs without much effort. URLs looks like this:

http://info.cern.ch/hypertext/WWW/TheProject.html

URLs consist of a resource type (http in this case), the name in FQDN format of the computer (info.cern.ch) that contains the resource, and optional port number for connecting to the computer just named, and a pathname for the resource itself (hypertext/WWW/The Project.html). Other information can be added to the URL as well, but file-type, machine-name, port number, and pathname are the essential fields.

When you browse through a W3 document, the hyperlinks pointing to other documents all represent URLs. When you select a hyperlink, your W3 client will read the attached URL and send a request to the appropriate server for the linked document. Most of the time this happens behind your back, and you don't need to be particularly conscious of URLs to use of the Web. However, many browsers will also allow you to steer through the Web by entering URLs manually, and occasionally, this is just what you'll want to do.

The client software you use to look at hypertext is called a browser. Browsers give you a clear view of where the links are in hypertext document and a way of following links from one document to another. W3 browsers are also client programs: they interact with a server to retrieve documents; and of course, the W3 server must work with browsers in all sorts of display environments. Among W3 clients, you'll find ASCII line-mode browsers, several full-screen browsers for use with ASCII terminals, and browsers for graphical user interfaces (GUIs) such as Xwindows, Microsoft Windows, and the Macintosh. If your Internet access is via a conventional dialup connection, you'll need either a full-screen browser like Lynx or the line-mode browser www.

If your computer has a graphical user interface and you access the Internet via a protocol dialup connection, there are a number of GUI browsers available. You can reach W3 resources with any kind of browser, but GUI browsers can use your computer's audio and visual capabilities to make Web browsing more enjoyable. The examples in this chapter will use either the line-mode browser or Cello Browser for Windows. Cello is available from the Legal Information Institute at Cornell University. Another popular browser that is available for Windows, X Windows, and Macintosh is the Mosaic browser from the National Center for Super-computing Activity (NCSA) at the University of Illinois, Urbana-Champaign. The line-mode browser is the most primitive, but it has the great advantage that you can use it with almost any display terminal and with any kind of connection to the Internet.

To start the line-mode browser, log into your Internet access provider's computer, type www, and press J. If your www command results in a "www: Command not found" message, try again using the full pathname: /usr/ local/bin/www. If this also returns a "Command not found" message, the line-mode browser is probably not installed on the machine you use for Internet access. If you don't have local access to the line-mode browser, you can still access W3 by using telnet to connect to info.cern.ch. (CERN is the home of W3.) The line-mode browser will start as soon as the telnet connection is made. Full-screen browsers are a step up. They show you W3 documents a screen at a time and use the display capability of your terminal (highlighting, reverse video, or underlining) and cursor-movement keys. You can use a full-screen browser over any kind of Internet connection, but if you're working on a UNIX system, you'll have to tell it what kind of terminal you're using. There are several browsers available. The Lynx browser was developed at the University of Kansas, and offers a good selection of features. It allows you to search through the current document for strings. This is particularly useful if the document contains more than a few links. It also supports bookmarks. If you'd like to test the Lynx browser, telnet to ukanaix.cc.ukans.edu and log in as www.

Another full-screen browser is www. To use this browser, telnet to www. njit.edu and log in as www. Instructions for retrieving these browsers via ftp appear in the sidebar above. Neither line-mode nor full-screen browsers will be able to display graphics or play sounds for you; for that, you'll need a GUI browser. For example, W3 can lead you to the catalog for an exhibit of medieval art and historical documents from the Vatican. With a line-mode browser, you can read the modern commentary from the catalog, but with a Gui browser, you'll be able to see the pictures and view facsimiles of the documents from the comfort of your own computer.

Some GUI browsers will allow you to look at several documents at once in different windows. The drawback to GUI browsers is that they are very resource-intensive. Running a GUI browser on a slow modem, a slow computer, or a computer that has only a modest amount of memory installed can tax your patience. Running a GUI browser on a fast modem with a fast machine and lots of memory will remind you why you invested in the fancy hardware in the first place.

When you first start any W3 client, you'll see the browser's "home page," a page of information that contains links to other documents. When you first start the Cello browser, it, too, loads its home page from a local file. In line-mode browsers, links to other documents are shown as bracketed numbers following the keyboard or phrase to which the link is made. At the bottom of the screen there is a prompt that gives you the range of links from which you can choose and a selection of the browser's built in commands. To follow any link in the current document you type the number of the link. For help with the browser's commands, type h or help.

All the browser's commands are triggered by pressing J. Pressing j without first entering a command advances the display to the next screenful of the current document. A description of the most important line-mode browser commands appears in the following sidebar. GUI browsers mark the words or phrases that have hyperlinks attached in a way that doesn't disturb the document's on-screen format. Cello browser's home page is loaded from a file (default .htm) in the directory where the Cello browser is installed. Words that have links to other documents are underlined.

To retrieve the contents of a hyperlink, you simply click on the link. This page contains hyperlinks for the top-level document at CERN that we'll look at below. To get to these documents, scroll down in the home page (using the mouse or the PgDn key) to the hyperlink for CERN. Click on this and Cello will retrieve the Overview document from CERN. GUI browsers typically provide a number of menu commands that can be used to manage your W3 sessions. In addition to navigation from document to document, the Cello browser includes a jump feature for moving directly to different documents or even starting other Internet applications without going through intervening menus or documents. (Cello can also be used as a gopher client, for example.) Cello also maintain a history list of URLs visited in the current sessions and a bookmark list.

As with gopher, the W3 browser commands don't begin to describe what you can do with W3. Fortunately the Web has been set up with a few key documents that serve as navigation tools to help you get and stay oriented. These tools are:

— the CUI W3 Catalog
— the W3 Virtual Library (a Subject Catalog of W3 resources)
— the W3 List of Servers
— the W3 Classification of Resources by Type

The CUI Catalog deserves special mention: it is a searchable index of W3 resources that provide for the Web the same kind of service that archie and veronica provide for other Internet applications. The CUI W3 Catalog is a relatively new addition to the W3 tool kit from the Centre Universitaire d'Informatique at the Universtiy of Geneva in Switzerland.

The great advantage of this catalog is that you can submit keyword queries to find resources you're interested in. The response to your query will come back as a hypertext document with descriptive text for each resource and a hyperlink to take you to its full text. This catalog hasn't yet found its way to the CERN overview page. It is so important a resource, however, that it's worth learning the relatively simple URLs that lead to it and setting a bookmark that will get you to this catalog easily.

http://cui www.unige.ch/w3catalog

http://cui www.unige.ch/cgi-bin/hygrep/file =W3 catalog/
isindex.html

There are two URLs because the catalog has two interfaces. The main interface for the CUI catalog is set up for newer W3 Clients that support query by forms. (The NCSA Mosaic browsers for X Windows, Windows, and Macintosh have this feature.) The second URL is for clients (like the line-mode and Cello browsers) that don't yet support query by forms. If you're using the line-mode browser, you can use the URL above with the go command. From the Cello browser, choose the Jump menu button and the URL option from the pulldown menu that follows it. This will bring up a dialog box into which you can type the URL above.

The Cello browser's view of the CUI catalog, a query for entries containing the phrase world cup has returned several hits. Items that satisfy a query are returned in chronological order, with the most recent item first. The world cup query returned several items, among them a pointer to the W3 server for Palo Alto, CA. As this example shows, the CUI W3 Catalog is particularly adept at finding W3 resources that might slip through the cracks* of a subject oriented index. The Palo Alto Web server is just the sort of thing that might otherwise be missed.

The W3 Virtual Library is a subject catalog of resources that can be reached from W3. The subject index covers everything from Aeronautics to Sports. Cataloging resources systematically by subject is not widely done on the Internet. (An effort is underway to classify gopher resources by subject, but it is far from complete.) It is a refreshing change to be able to think about the subject matter you want to investigate instead of guessing at likely names for files that might have something to do with the area of interest.

As you page down the list of subjects, you'll encounter the "Music" category. When you select this category, you'll be led to a list of W3 resources devoted to various forms of music. Near the bottom of this document is an entry point for the Digital Tradition Database. (If you're using the line-mode browser, you'll notice that the prompt has changed to include the word FIND. In the Cello browser, a separate dialog box will prompt you for keywords.) To search for songs in this database that refer to the town of Carlow, you simply enter Carlow and press Return.

The CERN Overview document contains a hyperlink that leads to a classification of Internet resources by application type (that is, gopher, ftp, WAIS, WWW). When you jump to this listing, your browser will bring up a W3 document that is gateway to other Internet applications. From this single page in W3you can branch to approximately two dozen Internet applications or sources of information. Some of these services (archie, ftp, gopher, and teinet) may already be familiar to you. You'll even find a hypertext version of Scott Yanoffs Internet Services List, containing links that take you directly to many of resources it contains. Other services may still be unfamiliar to you. You can get to them all from this menu. When you use W' as a gateway to other applications, the user interface will resemble W3s.

You can also use W3 to perform archie queries and retrieve files via ftp. From the Web Overview document, follow the link to the "By Type" document. Then select "full hypertext archie gateway," and you'll see the menu. From this screen you can select any of several kinds of archie query and specify the keywords to be used in searching the archie database. As with the CUI W3 Catalog, there are different selections for browsers that support form-based queries and browsers that do not. W3 also provides a choice of archie hypertext servers for you to use.

The databases at these sites vary somewhat, and a query that returns no results from one of these databases may find items on another. In this example, the keyword tomato is entered. The results of the query are displayed as a page of hypertext that provides hypertext links for the filename that matched the keyword, the directory that contains that file, and the site that maintains the ftp archive in which the file was found. Selecting any of these links will open an ftp session to the host selected. Selecting the file link retrieves the file and displays it on the you screen. Selecting the directory link provides a menu of all the files in that directory. Selecting the host link opens an ftp sessions starting at the topmost ftp directory on that host.

Another Internet institution is the FAQ, a compilation of Frequently Asked Questions about some topic. FAQ documents exist for hundreds of topics discussed on the Internet, and they're a very helpful form of documentation if you can find them. Many FAQs are posted to Usenet newsgroups regularly, but finding the right newsgroup can sometimes be difficult. W3 simplifies this dramatically by collecting links to more than 300 FAQs (about all sorts of topics) in a single hypertext document. In the By Type document, move to the Network News item. In the short description that accompanies this item there is a hypertext,link to a list of FAQs. Once you've jumped to this list, retrieving an FAQ requires only that you select a link from this list.

Finally, if you want to get an overview of the World of W3 servers, W3 itself is one of the resources in the classification of services by type. When you select the WWW Servers item from the Services By Type document, a menu of available W3 servers will be displayed. You can connect to any of the servers listed by simply selecting its link from this document.

From the list of W3 servers there is a link to an automatically collected list of "home pages" for various servers. This is a particularly useful list if you are working with either a fullscreen or a Gui browser that supports bookmarks. W3 is an application in transition. It is breaking out of its traditional role as a medium for academic communications, and being used for publishing all sorts of information in a visually exciting way to Internet audiences. For new users of the Internet, W3 provides a uniform interface for network applications. The Web's phenomenal growth continues as it provides an easy way to take advantage of multimedia.

The Internet community has developed its own conventions for documentation. Topics that are of general interest to Internet users are documented in RFCs (Request for Comments). RFC authors submit their documents to an RFC editor, who reviews the document, assigns it a number, and makes the document available on-line. Once an RFC has been published and the requested comments start to arrive, if changes are required,. new RFC is generated that renders its predecessor obsolete. Both RFCs remain in circulation, however. Many, but by no means all, RFCs address technical topics. Some RFCs are identified as For Your Information (FYI) documents discussing issues the entire Internet community needs to be aware of. Another subset of RFCs contribute to the definition of standards, and these are known as STDs. The RFCs themselves (and an index listing RFCs by number and title) are available from many ftp sites, including ftp.nisc.sri.com once connected, cd to the rfc directory) and nis.nsf.net (ed to internet/documents/rfc). Following is a selection of introductory RFCs:

RFC 1118 Hitchhiker's guide to the Internet.

RFC 1175 FYI on where to start: A bibliography of internetworking information.

RFC 1206 FYI on Questions and Answers: Answers to commonly asked "new Internet user" questions.

RFC 1207 Fyi on questions and Answers: Answers to commonly asked "experienced Internet user" questions.

RFC 1150	FYI on FYI: Introducing to the FYI notes.
RFC 1208	Glossary of networking terms.
RFC 1087	Ethics and the Internet.

If your connection to the Internet is via a local UNIX network at your business or educational institution, you've probably already learned the login procedure, and you can skip. If not, read on... When you connect to the Internet via phone you'll have to log in to your Internet access provider's computer. Internet access providers use all sorts of computers, but it's very likely that your Internet access will be via a computer running the UNIX operating system.

Before you can log in to a UNIX system, you must have arranged with you Internet access provider for a login account. Your access provider will give you the login name and password for your account. Whether you have a conventional dialup connection or a protocol dialup connection, you'll have to log in to begin work. Logging In tells the computer who you are. Your login name (or user name) is your on-line identity. It determines what files, directories, and programs you can work with. Any files or directories you create will be stamped with this identity, so that you can control access to them. All login names should also be protected by a password known only to the authorized user of the login account.

Many UNIX systems have a bare-bones login Prompt that looks like this:

```
login:
```

The prompt may be embellished with a brief message that identifies the computer or gives you any special login instructions for that system. In response to the login prompt, enter your login name exactly as it was assigned by your Internet access provider. UNIX systems are case-sensitive, so be careful about capitalization. The characters you type in response to the login prompt are echoed on the screen as you type them. If you make a mistake, you can back over the letters you've already typed one at a time by pressing the Delete key.

On some systems, you may find that the Delete key doesn't backspace over mistyped entries. If this happens, you can try using the Backspace key or simply press J at both the login: and Password: prompts. Your login attempt will fail and return you to the login prompt where you can try again. When you've entered the login name correctly, press j the key. You should almost immediately be prompted for your password:

Password:

Enter your password. At this prompt, characters you type are not echoed on the screen. This is intentional: maintaining the privacy of your password protects your login account, the computer, and the network from unauthorized use. Even if you aren't concerned about your own account, carelessly publicizing your password could compromise the security of other users or the network itself. When you choose a password, you should avoid words (your name, for example) that are easy to guess. You should also avoid words that might occur in common word lists (like the word list used by the UNIX spelling checker). It's a good practice to mix upper-and lowercase in your password and to include at least one number. Change your password frequently. You can correct typing mistakes in your password entry by using the Delete key carefully to backspace over the mistyped letters. If you've entered your login name and password correctly, you'll be admitted to the system. What happens next depends on how the computer is configured.

After you've logged in successfully, the system may need some additional information to set up your session correctly. The most common piece of information asked for is your terminal type. Be prepared for something like this:

```
Term? (vt 100)
```

This prompt asks you to enter the type of terminal you're using (for users connecting to the UNIX system from another computer, this means the type of terminal your communication software is emulating). The prompt above proposes vt 100 as a default. Vt 100 terminals were built by the Digital Equipment Company (DEC); but. many terminals behave like vt 100s, and vt 100 is a common terminal emulation.

The selection of a terminal type affects the way things look on your screen. UNIX has a database of features for common terminal types, and some of the programs/you run on the UNIX computer will check the terminal type you set and try to use features of that terminal. They do this by sending control codes the terminal recognizes. If the terminal type is set correctly, these control codes will do things like clear the screen, pOSItion the cursor, or turn special video attributes on or off. If the terminal type is not set correctly, your display may be difficult to read, and programs that try to control the screen may be difficult, to work with. If you know what sort of terminal you're emulating, enter an identifier for that terminal. Unfortunately, there is no university appropriate response to the question about terminal type.

On many systems the names "dumb" or "dialup" can be used to select a minimally featured terminal type that can be used safely. Once you're past the login procedure and have specified a terminal type, you will receive a prompt from the UNIX command interpreter (or "shell"). Exactly what the shell prompt is depends on which UNIX shell you use and how it is configured. The shell prompt can be something simple like $ (the default prompt for the Bourne Shell) or a % (the default prompt for the C Shell). Some Internet access providers use programs other than the standard command-line interpreters for a shell program.

In some cases, the first piece of equipment you interact with may be a terminal server and not an Internet host. A terminal server is a special-purpose computer that does nothing but manage connections between terminals or modems and the computers on a local network. When you connect to a terminal server you should see a message identifying the terminal server and brief instructions. Typically the first prompt to which you must respond is a request for a user name. In the example below, the user name for the terminal server is the same as the Unix login name. For some systems the' name you use for the terminal server may be different from your UNIX login name.

```
Connect 9600

        Welcome to the Xyplex Terminal Server.

Enter username> bennett

Xyrmt7> c optimise

Xyplex 010 Session 1 to Optimism established

        SunOS Unix (optimise)

login: bennett

Password:

Last login: Fri Sep 3 10:37:44 from yoda
```

Terminal servers are not usually protected with a password. After you've entered a username the terminal server will start a session for you, and you can issue commands to the terminal server to start a login session with a host. You'll need to know the name of the host that you're authorized to log into. in the' example above, the host was named "optimism," and the command c optimism made a connection to that computer so the user bennett could log in. Terminal servers recognize only a few commands.

Most terminal servers include a help command that you can execute by typing help, h, or ?. There are only a few ways the login procedure can misfire. By far the most common is that the login name or password is entered incorrectly. When this happens, you'll see a "Login incorrect" message and be returned to the login prompt to begin again. Different systems respond to login failures in different ways, and you should read carefully any messages or instructions that are displayed after a login attempts fails. At any point you can interrupt the login procedure and start again by typing Ctrl-D

Occasionally during' the login procedure, the computer may decide that you're on a terminal that can't distinguish between uppercase and lowercase. When this happens, everything displayed by the computer will be uppercase, and letters that ought to be capitalized will be accompanied by a "\". Here'a an example of this type of login sequence:

```
Ibm Aix Version 3 for Rise System/6000

(C) Copyrights by Ibm and by others 1982, 1991.

Login: Bennett

3004-030 You Logged in using all uppercase characters.

    If your workstation also supports lowercase
    characters, log off, then log in again using lowercase
    characters.

\B\E\N\N\E\T\T'S\ Password:

3004-007\you entered an invalid login name or
```

password. In this situation, the system may have difficulty recognizing your login name or password. You can use Ctrl-D to recycle the login procedure and start again. On some systems you may be able to log in successfully even when the login program thinks you're on an uppercase-only terminal. When this happens, the system will continue to display everything in uppercase, using a '"\"' to introduce characters that really are capitalized. Once past the login procedure you can recover from this. In response to a shell prompt, type the command:

```
% Stty- Lcase
```

This lets the system know that your terminal can handle upperand lowercase characters, and mixed case will be used from that point on.

So many of the computers on the Internet are UNIX systems that it is a real boon to be familiar with some of the basics of UNIX, even if the computer you work with directly is not a Unix system (for example, if your Internet access is through a dialup service that uses UNIX computers). UNIX is a multiuser, multitasking operating system developed twenty-five years ago at Bell Laboratories. Many of the design features of the original UNIX systems are still present in today's versions. The elements of UNIX that most affect users are its file system (a collection of files and directories organized in a treelike structure) and its operating environment.

The UNIX directory hierarchy is a tree-shaped structure that allows users to refer to any directory or file& on any disk without having to know which disk contains the directory or file. (Many other operating systems, including DOS, organize their file systems into this sort of directory hierarchy.) The entire file system is a series of directory paths that branch, off from a "root" directory. Directories can contain files or other directories, and the names of directories can be strung together to form path names. To refer to the root directory in a command, use a slash character (/) by itself. If the/occurs at the beginning of a path name, it is a reference to the root directory, and path names that begin with/are called absolute path names. The/ character is also used in path names as a separator for directory or file names. Here are some sample absolute path names:

The root directory

/usr A subdirectory of the root, named usr.
/usr/bin A subdirectory of /usr, named bin.
/usr/bin/finger The full pathname for the finger program in /usr/bin.

While you're logged in to a UNIX system, your login session has a current or working directory. By default, this is the home directory that the 'system administrator (whether for your local UNIX network or for your access provider) has allocated for your login name. During a login session you can change the working directory, but you'll always be in one directory or another throughout the session.

Path names that don't begin with "/" are relative path names: they are interpreted in relation to your current working directory. When you're compOSIng a relative pathname, you can use a period 0 to refer to the current directory and a double-period (..) to refer to the parent directory of the current directory. UNIX provides many commands to manipulate files and directories. The commands you'll use most often are is (list a directory's contents), cd (change directory), and pwd (print working directory). There are more detailed explanations of these commands.

When you log in to a UNIX system, you'll work with a command interpreter or shell program that accepts commands, executes programs for you, and manages the environment of you login session. There are three common shell programs in use on UNIX systems today: the Bourne Shell, the Korn Shell, and the C Shell. The Bourne and Korn shells are similar. The default prompt for them is $. The C Shell is different, particularly in its commands for managing the shell environment.

The default C Shell prompt is %. Regardless of which shell you use, your login session's environment will consist of variables whose values control your access to commands and how the system behaves. By resetting these variables, you can customize your login session. Common items in the UNIX shell environment are

HOME	Full pathname for your home directory.
LOGNAME	Your login name
MAIL	Full pathname to the file that is your system mailbox.
PATH	A list of directories that the system will search to find commands you execute.
SHELL	The default command interpreter for your login account.
TERM	The terminal type you're using.
TERMCAP	Either a description of your terminal's capabilities or a full pathname to the file containing the terminal capabilities database.

The environment variables that have the most dramatic effect on how your login session behaves are PATH and TERM. If the TERM variables is not set correctly, you may have difficulty using programs (such as terminal-based client programs for gopher or W3) that try to manipulate your screen. The Path variable controls the list of directories that will be searched when the shell needs to look up a command for you. If you know what directory a program is stored in, you can always execute the program by typing its full pathname. For example, if the finger program is in /usr/bin, you can execute finger by typing:

```
%/usr/bin/finger resebodywell.sf.ca.us
```

However, if the PATH variable in your environment includes the directory /usr/bin. you can execute finger by just typing its name:

```
% finger resebodywell.sf.ca.us
```

On most UNIX systems, you can have access to everything you need with only few directories in your path: /bin, /usr/bin, /usr/local/bin. You may also want to add /usr/etc and, if your system has it, /usr/ ucb. If you're working with a commercial Internet access provider, you should not have to figure out for yourself what directories should be included in your PATH.

On some systems, your current directory won't be included in the PATH by default. This can be very frustrating when you try to execute a program in the current directory. The is command shows that the program is there, but attempts to execute it by name fail with a "Command not found" message. You can execute the program by full path name, execute it by relative path name (/programname)), or add the current directory to your PATH.

Some application programs can be configured with environment variables as well. For example, if you want the World Wide Web line-mode browser to start up with a different home page, you can set the WWW_Home environment variable to indicate which page should be used. How you set environment variables depends on which shell program you use. The Bourne and Korn shells use the same syntax to set variables. For example, this is how to set the PATH variable using either of these shells:

```
$ Path:/bin:/usr/bin:/usr/local/bin::

$ export Path
```

The variable is set in the first command. The export command makes the variable available to any programs you start from the session in which the variable was set. To do the same thing in the C Shell, use the setenv command:

```
% setenv Path :/bin/usr/bin/local/bin:
```

When you're entering directory names for the PATH variable, use a colon to separate the names. If the list of directories begins with this character, your working directory will be searched first. Directories are searched in the order they appear in the PATH variable. If you want to place your current directory elsewhere in the PATH variable, use... at the proper location. For example, Bourne shell users can put the current directory at the end of the PATH with this command:

```
$ Path: /bin:/usr/bin:/usr/1oca1/bin...

$ export Path
```

With the Bourne or Korn shells, the set command can be used to display all the variables in your environment. C shell users should use the command printenv. To examine the value of only one variable, use the echo command. For example, this command displays the current PATH setting:

```
$ echo $Path :/usr/local/bin:/usr/ucb:/bin:/usr/bin:
```

When a variable name is preceded by a "$", UNIX substitutes the current value of the variable. The same convention is used for all the shells. UNIX systems offer a number of programs for editing files. (Among Internet tools, you'll need to edit fliles when sending mail or posting to USENET newsgroups.) One of the most convenient editors on UNIX systems is named vi.

From the UNIX command line, you can start the vi editor by typing its name and pressing J. If you want to edit a file that already exists, include the filename on the vi command line. Some mailers and news readers will start the vi editor automatically when you need to edit a mail message or news posting. When VI starts, the screen clears and the first screenful of the file you're editing is displayed. If you're editing a new file, vi will clear the screen and mark each line with a "" Screen lines marked with "" are not part of your file, and you can't move the cursor into this portion of the screen.

The vi editor has a rich command set, but you only need to know a couple of commands to use it for brief messages. vi is a "modal" editor, and it is always in one or three modes: insert mode, cursor movement mode, or command mode. Vi starts in "cursor movement" mode. You can move the cursor around using four keys: h (left), j (down), k (up), and i (right), When the cursor is pOSItioned where you want to enter text, you can enter "insert" mode by typing i. In insert mode anything you type will be inserted into the document. Vi does not break lines automatically. You'll have to press J at the end of each line.

While you're in insert mode, you can backspace over characters, but vi's cursor movement commands won't work. When you're finished entering text, press the Escape key. This turns off insert mode and returns, you to "cursor movement" mode. To save your work and quit the editor, first enter command mode by typing a colon(:). The colon will be displayed on the bottom line of the screen. Next type wq and press j to write your changes and quit the editor. (If you just want to exit the editor, type q! instead of wq.). By design, UNIX systems use a large number of single-purpose commands. Here are brief summaries of sixteen of the most commonly used UNIX utilities.

Some of the following commands require file names or directory names on the command line. (Anything following the name of a UNIX command on the command line is called a command line "argument.") For may UNIX commands, arguments are optional. In the commands that follow, optional arguments appear in square brackets, with an indication of what sort of argument is expected. For example, an optional filename argument is shows as [filename].

```
cat filename
```

Display the named file on the screen. Similar to the DOS TYPE command.

```
cd [pathname]
```

Change the working directory to the named directory or to the user's home directory if pathname is omitted.

```
Compress filename
    or
Compress -d filename
```

Compress (or, with the d option, decompress) the named file. The compressed file is named filename.Z. Compress appends a ".Z" suffix to the name of the input file, even if the input filename already had a suffix.

Compressing inet.services.txt, for example, would produce a file named inet. services. txt. z. The compressed file will be one-third to one-half the size of the source file. Compressed files are binary and should be passed through uuencode before being dent via mail.

The decompress option looks for filename.Z, decompresses it, and strips off the Z suffix creating a destination file that has the same name and the same size as the source file.

cp filename newname.

Make a copy of a file. If newname is a directory, a copy of the file will be placed in that directory.

grep pattern filename

Display any lines in the named file that contain the specified pattern

head filename

Display the first few lines of a file.

ls [pathname]

List the contents of the named directory or the current directory if pathname is omitted

mkdir dirname

Create a directory with the specified name.

Rename a file, or if newname is a directory, move the file to that directory.

passwd

Change your password.

pwd

Print the name of the current working directory,

rm filename

Remove the named file. Be careful, there is no way to "undo" the effects of rm.

rmdir dirname

Remove the named directory, which must be empty.

tail filename

Display the last few lines of a file.

uudecode filename.uue

Convert ASCII-encoded files to binary. Binary files can be converted to ASCII for e-mail or news posting with the command uuencode filename < filename > filename.uue

who

List currently logged-in users.

For a full explanation of these commands, use the Unix on-line.. manual. For example, to see the on-line article about the is command, s type man Is.

We must be very careful when implementing OSI standards. The OSI furnishes broad guidelines for the definition of managed object classes and management operations, but it does not go into specific implementation details. While implementing standards, modifications may be made, and definitions and guidelines may be expanded to suit individual cases. Also, in some cases, the definitions are in place, but the details are still being worked out. In such cases, individual implementations need to be formulated.

We will present a brief overview of OSI concepts; however, because it is beyond the scope of this book, we will not go into much detail on OSI layers below the application layer. For interested readers, there are many good books and OSI standard documents. Some commonly used OSI terms are:

— *Reference model:* This is the popular OSI seven-layer architecture and is used as the basis for the OSI standardization effort.

— *Service definition:* This is an abstract concept, and it includes a set of functions provided to the user of a layer. However, in the case of the application layer, the user is an application process. The service definition defines the capabilities that can be provided to a service user.

— *Protocol specification:* This furnishes a set of concrete rules which govern the interaction between two service providers and provides implementation guidelines. As conformance requirements and testing relate to the implementation of protocols, they apply to protocol specification only. Most of the OSI layers have service definition and protocol specification documents.

In data communications, we often hear the term *entity*. Basically, an entity is an abstract concept. An entity is that which provides services. These services can include error recovery, segmentation, and assembly. These entities provide the services of the *service access point* (SAP). The SAP is an addressing concept. It is a conceptual intersection between two layers and is referenced as the address by an upper layer that wants to access the services of lower layers.

So an (N)-layer is accessed by the (N+1)-layer using the intersection point address. In this (N+ 1) address AddrB is important and is subject to OSI standardization. As far as AddrA is concerned, it is a local matter, and it is not within the purview of OSI standardization. *Primitives* furnish further details on a state. There are four primitives: request, indication, response, and confirmation. When a request is sent, the sender may wait for a reply. In this case, the request is known as a *confirmed* request.

In some cases, the sender may not bother for a reply to come from the responder. In such a case, the request is known as an *unconfirmed* request. These requests and responses sent between a manager and an agent have their own distinct names: request, indication, response, and confirmation. When a requestor sends a message asking for a certain service to be performed by the responder, the requestor sends it in the form of a *request*. On the responder side, correspondingly, the responder receives a message asking the responder to perform a service. This becomes an *indication* on the side of the responder. When a responder has to send some message, it sends it in the form of a *response*. On the receiving side, the requestor sees the message as a *confirmation*. In the preceding explanations, the broad term *message* is used to avoid the confusion that might arise if we referred to it with names such as event report, notification, command, or response. When specific terminology is required or clear distinctions are necessary, such terms will be well-defined and explained.

Each service will have an indication about the layer: for example, A, which refers to an application layer; a verb such as ASSOCIATE; and a primitive such as request. An example of a service is thus A-ASSOCIATE. request. Each service has parameters which convey information, including data and controls. OSI and ITU-T protocols use a *finite state machine* (FSM) to explain functional aspects of the protocols. FSM is a mathematical modeling concept used to describe properties and behaviors of a system. A *state* is a distinct stage in a set of possible circumstances. In an FSM, there is an initial or starting state. A system begins its operation from the initial state. Some examples of states are *active, busy,* and *idle.* Events occur because service primitives, such as A-ASSOCIATE. req, are received from a user. This event triggers an action or actions. An action causes a transition or change of state to happen.

FSMs are represented graphically by a *state transition diagram* and *state transition tables*. State transition tables use tabular structure, listing all the states in columns, and the events in rows. The intersections of rows and columns represent possible actions, which may also include transitions.

In a systems management standardization effort, this document is a good starting point. It basically covers the following areas:

— Terms and general concepts

— Systems management model

— Informational model

— Systems management functional areas

— Systems management standardization framework

OSI management was motivated by the need to control, coordinate, and monitor the resources of open systems. Management information exchange using systems management communication protocols is done between sys*tems management application entities* (SMAEs). SMAEs are located in the application layer of our OSI seven-layer model. A manager has the responsibilities for activities such as configuration management. To collect the data on configuration, a manager has to send commands or operations to collect it. In return, the manager receives replies to its commands. In between, if something goes wrong, the manager may get unsolicited information or notifications.

As an example, if component X has gone down, the manager would need to update its configuration database. For this, component X, which is represented as a managed object, may send a notification to *an agent.* Component X may be in the same system as the agent or may be in another system. The agent, in turn, will send a notification to the manager with the information that component X has gone down. Accordingly, the manager may update its configuration database.

Hence, a manager collects and collates the information received from the agents. A manager's responsibilities also include system administration functions. A manager may control the operation of remote agents. It may send commands and actions on the basis of information received from agents. An agent can be on a workstation and must be present wherever accessing of resources is required. The agent has its own important role. It performs the following functions:

- An agent must manage its own environment, in which it must interact with managed objects. A workstation may have many objects defined, such as a printer, modem, mouse, and so on. The agent interacts with managed objects representing these resources and controls their operations. However, this interface is not standardized by the OSI.
- When an agent gets commands from a manager, it acts upon these commands and accordingly manages the managed objects. A manager may send a command to an agent to set the font in an object such as a printer. Here, *font* may be an attribute of the managed object *printer*.
- An agent may get some notifications from the managed objects. It forwards them to the manager. As an example, a printer attached to a workstation may be defined as a managed object. In turn, this managed object may send a notification or a message, which says that it has run out of paper. This must be forwarded by the agent to the manager.

However, in OSI standards, the roles of a manager or the boundaries between manager and agent roles are not strict. A SMAE that is a manager in one interaction may take up the role of an agent in another interaction. Similarly, a SMAE that was an agent may take up the role of a manager.

OSI standards do not cover how an agent deals with a managed object. OSI standards also do not state how an agent handles the managed objects that are outside the managed system boundary. As an example, an agent may ask for details on objects from another agent. In this case, the other agent forwards its data to the agent that asked for details. This is also not within the purview of standards. For a manager and agents to communicate, each must know about the other; thus, the *application context* (AC) must be known.

AC refers to the application service elements used between a manager and agents and the protocols used. Also there is a need to know which functions and functional units are supported by a manager and agents. Then, a knowledge of the managed object classes supported by agents and the relationships between functions and managed objects should be known. This is known as *shared management knowledge* between a manager and an agent. This shared management knowledge is made known before an association is started and is stored in some file and restored every time an association is made between a manager and agent, or during the association establishment phase. While establishing an association, it must be possible to change the shared management knowledge.

There are different terms associated with the starting of a manager and agent communication. Before system management operations, the manager and agents should know what to expect and how each one behaves. Each one will have to know the parameters, such as security features, that will be used. This is done differently in different protocols, and we will examine each one of them in respective chapters. The terms associated with the initial phase of manager and agent communication are:

— *Association:* Associated with CMIP

— *Affiliation:* Used in CMIP over LLC

— *Community:* Popular term for association in SNMP

OSI management comprises systems management, (N)-layer management, and (N)-layer operation. This threefold division should account for all possible situations that could arise in management, as we will see later. Systems management covers managed objects in all seven OSI layers, including the application layer. It assumes reliable connection-oriented end-to-end transfer of management information. There is a caveat here: The OSI management framework does not preclude the use of connectionless services. In layer management, the management of managed objects is limited to those in a particular layer.

The management protocols make use of the communication protocols of lower layers. (N)-layer management is useful when it is not possible to go for all seven OSI layers. In such a case, we can use the layer management protocol, because this is strictly applicable to a particular layer. Layer management should not duplicate the systems management. An example of layer management is LAN/MAN management protocols which are limited to layers 1 and 2. Finally, (N)-layer operation is limited to monitoring and controlling a single instance of communication of management information within a layer.

Layer operation is sometimes required, because some layer protocols may contain management information. An example of management information is the parameters that are exchanged in protocol data units while establishing connections. The standards within (N)-layer management and (N)-layer operation are beyond the scope of OSI systems management standards. However, the OSI management information model can be used by layer management.

The basic systems management model assumes management operations and notifications between peer systems, This model facilitates the distributed aspect of systems management. Sometimes, these peer systems are designated as managing systems and managed systems. For systems management purposes, the roles of peer open systems are defined. One peer open system is assumed to take the role of a manager and the other peer open system is assumed to take the role of an agent for a given interaction. An agent may be distributed throughout the OSI environment.

A managed object is an OSI way of viewing resources for management purposes. A resource can be described as a managed object. A managed object is an instance of a *managed object class*. A managed object class is a collection of packages, which can be mandatory or conditional. In packages, similar characteristics are grouped together. If we define *printer* as a managed object class, a Lexmark Laser Jet printer is an object instance; an HP Deskjet 560C would be another object instance. For controlling the activities of resources, the manager and agents need to be aware of the details of the resources. The details of these managed objects, which are required for management purposes, are stored in a conceptual repOSItory known as the *management information base* (MIB).

The MIB is a conceptual model and it has no relation to how the data is physically or logically formatted and stored. Standards do not cover the storage aspect. Nevertheless, the syntax and semantics of how the information is exchanged are governed by the OSI protocols. However, these managed objects must be properly formatted for management purposes. The retrieval of data from the managed objects may involve the use of communication services provided by the layers below. For OSI management, we have to take into consideration all the resources in the computer systems, including those related to data processing, data storage, and data communication. As an example, in fault management, we should consider the utilization of processors, bard disks, or CD-ROMs.

The definition of a managed object must include properties. These properties with specific values that can be exchanged are known as *attributes*. The type of printer—e.g., dot matrix, laser jet, or laser printer—can be one of the properties. A managed object class definition must also include *operations* that can be performed on a managed object. Modifying or querying attribute values are examples of operations. Managed objects can send *notifications* if a certain event occurs. A notification is an unsolicited message, which contains details of the message, including why a notification has occurred, where it occurred, and for whom the notification is intended.

When the characteristics of a managed object, such as attributes, operations, and notifications, are defined, there must be a way to express their semantics and how they are related. This is done by *behavior*. These characteristics must be capable of manipulation by management operations. There are two types of managed objects. One type of object, known as an *(N)-layer managed object is* relevant to one OSI layer. The other type of object is known as a systems *managed object*. Here, the systems managed object is used for systems management purposes and covers more than one layer.

For definition of managed objects, we perceive conceptually the managed objects as having a boundary. The characteristics of managed objects used for systems management are visible at and beyond the boundary. These characteristics include attributes, operations, notifications, and behavior. Hence, what is of interest are the properties at or beyond the conceptual boundaries. What is inside the managed object boundary is not needed for systems management purposes. The process of creating a managed object as per rues is known as *instantiation.* For example, when a Create on a managed object class, tokenRing, is done, then a managed object created with, say, tokenRingID = 1594 is known as an *instance* of a managed object class tokenRing.

The management knowledge management function can be used by an application process for systems management purposes. ISO 10164-16.2 primarily provides the model for the management knowledge objects, defines the management knowledge manage[object classes required, and maps management knowledge management function services to CMIS services. ISO 10164-16.2 ties up many loose ends and basically provides information on how a manager and agents can know about each other and how a manager can extract information on the managed objects managed by agents.

Management knowledge refers to the management information required by an open system to associate and perform management operations on another peer open system. There are three types of management knowledge:

— *Repertoire knowledge:* This relates to the capabilities of a managed system, which pertain to the classes supported, the systems management functions supported, and the name bindings. Repertoire knowledge assists a manager in identifying the capabilities of managed systems without accessing them.

— *Definition knowledge:* This refers to the formal specifications of managed object classes, name bindings, test categories, relationship classes, and the management information definitions understood by a managed system.

— *Instance knowledge:* This provides the information on the managed objects in a managed system.

Management knowledge has further subdivisions for repertoire knowledge and instance knowledge. Repertoire knowledge subdivisions are:

— *Managed object class knowledge:* This provides details on the managed object classes supported by a managed system, such as initial values of the instances of objects, the packages supported, the allomorphs supported by each managed object class, and the constraints on each of the managed object classes.

— *Naming schema knowledge:* This relates to the naming relationship between the managed objects made available by a managed system.

— *Relationship knowledge:* This refers to the relationship between managed object classes supported by a managed system and also the relationship of role bindings between managed object classes.

— *MIS-user knowledge:* This provides the titles, presentation address, application contexts, the functional units supported, and the management profiles of the SMAEs supported.

Relationship knowledge and MIS-user knowledge have instance knowledge. Instance knowledge relates to the object instances associated with relationship managed object classes and instances of agents. Instance knowledge has the following subdivision:

— *Managed object instance knowledge:* This provides details on the instances of managed objects which are made visible by a managed system.

For realizing the management knowledge manage-ment function, ISO 10164-16.2 defines 15 managed object classes under *top* and two repertoire directory managed object classes. Basically, the groups of managed object classes are:

- *Repertoire managed objects:* This refers to the information on the capabilities of a managed system, such as the managed objects supported and their name bindings.
- *Definition managed objects:* This provides details on management information supported by managed objects. These definition managed objects are useful while forming associations. Three types of definition managed objects are document objects, template objects, and ASN. 1 module objects.
- *Discovery managed objects:* This group has details on the managed objects made visible by a managed system.
- *Management knowledge directory objects:* These provide information on the capabilities and definition knowledge of the management systems. There are basically repertoire directory objects and definition directory objects under this category.

For the convenience of standardizing management, systems management activities are subdivided into different functional areas. Each functional area has specific responsibilities. The systems management functional areas are:

- Configuration management
- Fault management
- Performance management
- Accounting management
- Security management

Computer networks are expanding and becoming more complex. These networks need to be managed. The different components of networks cannot be managed without knowing where the various components are. Configuration management is used to locate the resources, including the failed ones, and also to keep track of the types of resources and their details. One of the key objectives of systems management is to maintain continuous operation of a network.

Components of a network are modeled as managed objects. These managed objects will have addresses and names to distinguish them. These can be stored in directories, and these directories can be built using OSI directory services. The data on managed objects, such as their state and how they are related to one another, is collected on a regular basis and, where there are changes, they can be collected in a manager, using unsolicited messages such as event reports. These changes must be reflected in the database on topology and status. These services may be used by other systems management functions such as fault management.

In addition, we may activate and deactivate managed objects. Sometimes, these may have to be done in a controlled manner. Also, we may want to change the configuration of the network. For example, a workstation may no longer be attached to network A; instead, it is now attached to network B. This change has to be known and accordingly reflected in the configuration. In addition, we may wish to change the parameters of systems. Most of these activities have been standardized by the configuration management functional area of systems management. We also need to manage day-to-day operations of the systems and resources. The configuration management function provides the support services to keep the systems and resources operational.

Software management is within the configuration management functional area of OSI systems management. With the widespread use of computers, this is becoming an important function. When new computers are set up, software needs to be installed. It is not possible to hand-carry the diskettes for installing software; there should be a way to distribute the new software for installing new systems. Once we have systems installed, they need to have the latest versions of software. In some cases, we need to apply fixes to software problems that have cropped up.

The distribution of software fixes is a part of this function. Fixes usually should not be applied when a system is busy; this should be done at a particular time and requires a scheduling operation. We also need to keep track of the software installed, as well as fixes and versions. Sometimes this is referred to as *license management*, which is also a part of *change management*. Basically, change management involves all the activities that are required to keep track of changes in computer networks and the resources associated with them.

Though some of the goals of fault management appear to be part of other areas of systems management, each area must perform its part of the function, and sometimes cooperative functioning and management are required. For example, after we analyze system performance, we need to identify problem areas and take corrective actions to overcome them. We may use log services or a cache to store the data. We may also need the help of configuration management to identify precisely where a problem has occurred. Some form of automation routines may be required to apply fixes. For example, a token-ring lobe becomes nonfunctional. We may use automation to bypass the problem lobe and take some other corrective action to prevent a station from being disabled permanently.

Fault management is broadly concerned with the detection, isolation using analysis, and correction of unusual operational behaviours of systems in the OSI environment. These unusual operational behaviors include conditions such as deterioration of service and error situations. Effective fault management may require that errors be logged in a database. This error log may be in an agent or manager, depending on the situation. In some cases, an agent may not have much memory. In such a case, the error log may be off-loaded to a manager. In some other cases, error logs may be in agents and a summary is maintained in the manager. Where to locate the error log depends on requirements and implementation decisions.

For detecting and isolating complex faults, it may be necessary to examine error logs and run diagnostic tests. Sometimes traces may be helpful. After the problems are isolated, they are corrected. One of the trends in systems management is to automate as much as possible fault management functions. By automation, we mean a set of procedures which are triggered to correct impending and actual problems without human intervention. This set of procedures may be accomplished by hardware, microcode, software, or a combination of them.

When computers are working, we need to know how they are operating—for example, is the system getting overloaded? Is there enough workload? How is the performance during peak hours? How is the LAN behaving? Are there too many collisions while transmitting data? The answers to these questions fall within the realm of performance management. To undertake capacity planning, we need to collect performance-related data. What are our response time targets? Are we achieving them? Can we improve the performance with better load balancing? Is any system becoming a bottleneck? How can we improve the performance by removing the bottleneck? Some of these questions require historic data to be answered.

The historic data has to be stored in databases so that it can be analyzed, and correct answers can be arrived at. Performance management is also concerned with the behavior and evaluation of the effectiveness of resources. For this, we may need to gather statistical data on the behavior of resources and store the data in databases. We can use the data to evaluate the performance of systems and networks and fine-tune them to maximize overall performance.

Here we must consider how much of the resources are being used and how much must be charged for using these resources. The accounting information can be from individual, department, section, and company levels, depending on the rate structure. Accounting management includes informing relevant users and authorities about the usage of resources and the costs associated with their usage. In some cases, it may be enough to send monthly reports about computer facilities usage to managers instead of to individual users. In order cases, these reports may have to be sent to individual users and managers in the administrative chain. All these are included in accounting management.

In some cases, especially where computing resources may be necessary to set limits on the usage of resources. This is common practice in universities, where authorities do not want students to overload the centralized computing facilities. There are also cases where computing resources are out-sourced from some vendors and tight control on the usage of resources is desirable. Furthermore, costs on resource usage may sometimes need to be combined and consolidated. As an example, some people work from home using modems. It may be necessary to consolidate the cost of telephone tariffs for this kind of work with other costs.

Security management must be very carefully and patiently implemented. It has become an important issue, especially in distributed computing environments with thousands of workstations. There are different levels of security to correspond to different levels of computing environments. There are threats of viruses creeping into networks. Without adequate precautions, important company information may be lost, or proprietary work that is being done may be stolen. Security management is a very important function for dealing with these threats. Though systems management security is closely related to network security and computer system security, we will focus on security issues related to systems management functions, such as those dealing with accounting management and managed objects.

Some security management functions are:

- Reporting any security violations, using event reports to the manager, and maintaining logs. Unusual security violations must be brought to the attention of the network manager for prompt action.
- Creating, deleting, and maintaining security-related services like encryption, key management, and access control.
- Distributing passwords and secret keys as necessary when bringing up systems and at regular intervals afterwards.

The business management function is a collection of aspects from the configuration management, accounting management, and security management functional areas of the OSI systems management function.

Business management is an important function with much potential, and it needs to be included in OSI systems management. First, all the hardware, software, and computing resources used are registered. Then, whenever there is a new user, this user is registered along with the details of the resources being used. After collecting the details of all the computing resources, we use them to manage the cost. This is where financial administration enters the picture. The total cost of using the resources and how much is used by each individual user, department, or division needs to be computed. Business management involves more long-range and strategic planning than does accounting management.

A workload may increase or decrease, depending on the business climate. In such cases, short-term as well as long-term planning of data processing needs are appropriate. Once such plans are in place, they must be continuously monitored and updated. Facilities planning is also a part of business management. How Much of the resources will be located in a particular place? flow best to place the resources? These concerns are very important where working space is at a premium. Some functions of business management will be discussed in this book as they are applicable to other functions.

Systems management standards are pertinent to the application layer of the OSI. These standards can be broadly grouped into different areas. This classification indicates how these standards can be grouped to arrive at different systems management functional areas. Basic and general systems management services relate to the general explanation of systems management functions. The documents under this category furnish general guidelines on systems management standards. Many OSI standards, such as OSI layer standards, systems management standards, and standards or domains, fall under this classification.

The next category relates to the management information model. Standards under this classification provide definitions of managed object classes and generic managed object classes that can be used for systems management. They all have a starting number of 10165 and are grouped under the *structure of management information* (SMI).

Another group of standards relates to the specific systems management functions and includes object definitions required for them. They all start with 10164. Providing a systems management function such as performance management may require the help of more than one standard in the 10164 grouping. As an example, performance management may require 10164-11, which is the workload monitoring function, and 10164-13, which is the summarization function. Other standards are needed to implement interoperable systems management functions, including standards for association and for the syntax of data being transferred, and the protocols used for communication between manager and agent. ACSE, ROSE, CMISE, and CMIP are categorized under additional service functions.

Security is a major consideration, especially when distributed computing receives wider acceptance. All of these issues are included under additional service functions. These classifications are combined to make up the *systems management functional areas.* These SMFAs must be modular so that additional functionalities can be added more easily. For example, in the first release, all the bells and whistles required for security management may not be in place. These may be added in the second release or as the standards firm up. In some cases, depending on the needs and additional requirements, committees are set up to examine and formulate standards. This takes time, and must be considered when providing the systems management functions.

Once all the functions are provided, it is essential to ensure that for operations under different conditions and multivendor environ-ments, they conform to the provided standards. In India there are more than 43,000 computers linked to the internet, This includes dial-up and leased connection. This access is expected to increase considerably in the next two years. Besides there is no doubt that with the announcement of ISP policy and improvements in India's telecom connectivity through implementation of NII and the high speed telecom backbone is bound to bring a multi-fold increase in internet users in India. At present there are three types of internet accounts for which the price varies from Rs 15,000 to 550 for 500 hours. Now that the license fee for the entry of the ISPs has been waived for a period of five years instead of two years a lot of hope of hope has been raised. But the Internet Service Providers have to give a bank guarantee which is equivalent to one year's license fee. According to speculations the VSNL is going to lower the internet connection to Rs 10,000.

Internationally people pay only 1520 dollars a month which is indeed very cheap. A regular internet user says, "Already companies like UPS, the largest courier service providers are linked to the internet. So a customer only has to log into the internet and find out the status of his parcel." Many Indian software companies have taken the lead for creating products on internet and selling products through internet. Also many of them have shown the desire to become service providers for internet together with the VSNL, the nodal agency of the government. In the software industry, promotional efforts constitute as much as 70 per cent of the total product cost. But with the low cost of internet based marketing and high visibility of Indian software companies, internet gives a distinct edge to companies to market and distribute products in a cost-efficient manner and thus reduce the costs to as low as 30 per cent of the total cost.

Most of the computer hardware manufacturers are modifying their computer configurations to make them more Internet friendly. In 1996 alone, the market was flooded with many Web Servers. Before the launch of internet services in India by VSNL in 1995, there were only under 10,000 users in India. The current number of subscribers base in India boasts of around 43,000. Some of the most popular uses of internet in India are Web browsing, E-mail and FTP. "Currently the immediate fall out of the private ISPs will be that the browsing will increase more. Secondly there will increase more. Secondly there will be more quality sites coming up in India. With more Indian sites there will be more Indian sites there will be more Indian content of international standard. Also the large ISPs are going to provide virtual private network to corporate clients. This will increase the company's intra net. Also there will be extra nets to service their distributors, customers and partners therefore," True, the fallout will be the use of internet for more resource intensive tasks.

Internet will be deployed for commercial purposes which would include Home Banking, Tele-shopping, Electronic Commerce, Internet, Netvertising Internet Telephone/Video Conferencing, Collaborative Efforts, Real time Event relay. Web Varsities etc. This is important for a country where there is a great deal of cultural and economic disparity. According to current estimates, about 125 establishments in India have either set up or are in the process of setting up intranets. These are expected to increase to at least 12,000 by the turn of the century. The reason being that with PC penetration exploding in India, 'networked organisations and electronic commerce are becoming a way of life, increased focus on computeri-sation by the government departments and the corporate houses, intranet is seen as a viable and cost effective tool to exploit such strengths.

Also the acceptability of internet and its popular constituent, WWW, has been beneficial for the Indian industry to market its products and services. It has already helped Indian companies to create brand awareness, invite potential partners, etc. Internet will provide new opportunities to the telecom service providers and the value added service providers because they will have additional source of revenue. Internet being on the international superhigh-way has really increased by leaps and bounds all over the world which means additional revenue to all the telecom service 'providers. But the private operators have to pay attention to the quality to keep up to the international standards so that the people can use it for longer duration of time, with clarity of transmission and at a high speed.

President of Combit Advertising Network Limited says, "The government has yet to lay down the terms and conditions clearly although it has come out with outline, it has left a lot of grey areas. Liberalisation is the catalyst to the process where a wide array of society can get involved. If private operators come in then there will be more users which will help enlarge the market. in fact, it is only then that the real activity on the internet will come forth. Besides the techno-literate can provide decisive product and services. With the liberalization of the economy and emerging business and economic opportunities, the government has been considering the creation of a National Information Backbone (National communication carrying capacity). This backbone would be used for national information infrastructure and promotion of Internet Services.

The tele commission chairman, Mr. G.V. Gokak called for a comprehensive approach to integrate cyber-technology to lead proliferation of Internet users in the country. Commenting on throwing the sector open to private participation. Mr. Gokak said that it was the best possible way to ensure proliferation of Internet users in the country. Further elaborating the government' stand Vital says, "All this while the government has been playing on the security aspect as being the reason for not opening the sector. But in an era of no secrecy this excuse is very lame. There is no policing of software export elsewhere so why should we do it in India."

Dewang Mehta the Executive Director of NASSCOM remarked. Today in the world it is impossible to survive in the computer business without having the internet connection. The same applies for the business side. In the west all visiting cards have an internet number! "So in this era of globalisation India has to quickly get out of the agriculture age to enter the information age we have to concentrate on not only on the quantity of internet connection but also the quality." Predicts Nahata, "Growth of internet is going to be phenomenal and the usage is going to increase terrifically because new services are available on the internet including possibility of the voice communication. But this will most probably not be allowed as the it will come in direct conflict with the direct service operators. DoT and VSNL. However, even without that there are a lot of services available at a very cheap rate which will ensure the phenomenal growth beyond what we can contemplate today. A is going to explode. Also success would depend on the good quality of the service available.

"Today there is lack of a good transmission network. The way I foresee the demand of internet. DoT will also have to increase their capacity in intra-state transmission network. Of course. Private operators are then going to provide good network." But laments Dewang Mehta, "Somehow in this country. It is not that the demand is less. A survey done in the four metros show that the immediate demand for interest is 500,000. So it is not the demand ' that is bottleneck rather it is the supply which is the bottleneck and when that happens then we ought to go fai privatisation as government agencies do not have the infrastructure or the resources nor the willpower to take up this task."

Defending the role of VSNL Director (Development). R. K. Gupta opined. "The VSNL is unnecessarily being blamed and the criticisms are totally unfounded. In many countries the internet connections are owned by the government. So why not in India. We are providing competitive rates, quality." On the increasing use of internet services Vittal says. "Internet is no doubt becoming a competitor to voice telephoning. In India do we want to create an assumed monopoly of DoT. On one hand we have an aspiration that India should have the internet but will not allow them to grow by putting limitations. Because of the US, Germany, Europe and Japan are changing so we too need a wider vision if we want to link ourselves to internet."

Internet connection in India is only about 45 thousand in a country 1 billion when compared to the world. We are a great power in software, intellectually very sound, we have the second largest English speaking manpower in the world yet the percentage of the users are very low." Today in the World there are 40 million internet connections, which means 40m computers are connected to internet. Mehta comments, "Private sectors should be allowed to do the pricing themselves and let the market forces decide. The market equilibrium should not be interfered with the government.

7

Distance Program via Intenet

The wide use of the Internet and the most recent advances in telecommunications technology present an interesting challenge to the traditional educational paradigm where the notion of lecture constitutes the centerpiece of the educational model. The notion that the classroom is the basic environment for learning a discipline has been questioned in the recent years. In fact, since the use of the satellite and more recently the use of video conferencing concepts like that of the virtual classroom, distributed multimedia environment and the like have been a favorite topic in seminars and conferences worldwide.

In August of 1997, the department of computer science at James Madison University started a remote distance master program with a concentration in information security. The experiences of this program have taught us that, although not suited for everyone, it is possible to develop a new and "almost lectureless" paradigm for adult education.

As indicated by Aukstakalnis and Mott, "the great challenges faced by educators is to present ... concepts to students in forms which achieve the greatest measure of clarity and understanding." If we are to remain true to our role as educators, we need to ask ourselves, can we present concepts clearly and with a good measure of understanding through a remote lectureless program? Our collective experience has provided us with an optimistic view of the results and the fact that it is feasible task. However, to provide the reader with clear understanding of this new program let's first address the key issues of the target audience, and the modality of the remote distance program.

The program started during the third week of August, 1997 with a cohort of about 25 students. These students were all practitioners of the information security field with diverse backgrounds and experience in computer programming. All applicants worked full-time at private organizations or government agencies in the Northern Virginia area. Since it was clear that a program of this nature was not suitable for everyone, in addition to the normal requirements of the graduate school like GRE, letters of recommendations and the like, we requested an extended resume where we let the candidate "make" his or her case. Each student elaborated on his experience in the information security field and the relevance that the master program could have on his current job.

A committee of three faculty members reviewed the credentials of the applicants and made recommendations for acceptance into the program to the director of the computer science department. In those situations where there were doubts about a candidate, one or more members of the admission committee talked to the candidate to request further information. To provide an additional check, the director of the department reviewed independently the applicants recommended by the admission committee.

In cases where there was disagreement between the recommendation of the committee and the evaluation of the department head, the committee was asked to further justify its recommendation. There were about 80 applicants for the initial cohort. Since an undergraduate degree in computer science is not required to be admitted into the computer science master program at JMU, students that are admitted into the program but deemed deficient in computer skills are required to take three remedial courses. These three courses combined provided a good starting foundation in the areas of computer programming in C/C++, Computer Architecture, and Data Structures. All the students, including those who did not have to do it, took the remedial sequence.

The program is almost lectureless since the instructor of the course meets the students only twice. In an initial meeting, at the beginning of the session, the instructor presents an overview of the course and where it fits into the program. In a final meeting at the end of the course the instructors "wrap up" the course. This final meeting also includes a final examination. The remaining "sessions" of the program are via Internet with heavy emphasis on the use of electronic mail. Students are free to communicate with the instructor via telephone, fax, or by any other means. The students access all the information through a Web site which contains the course description and the activities that the student needs to perform such as readings, assignments, and some ancillary material that may have been prepared by the instructor.

Students are encouraged to participate in "threaded discussion groups" with minimal participation of the instructor, although the instructor clarifies any point that has reached a plateau and cannot be resolved by the students. It is important to observe that no specific questions pertaining to exams are allowed for public discussion. Students are requested to submit a "screen" name to the instructor. This name is used to post grades and all students have access to the grade screen. All courses last six weeks.

After completing four different courses, the opinion of all the instructors that have participated in the program is that the quality of the work is comparable and in some cases superior to the regular on-campus students. In this respect, the initial set of expectations of one of the authors of this paper (RAMT) was not high. He erroneously assumed that the lack of direct supervision on the part of the instructor would hinder the students' performance.

The statistical results shown in the appendix indicate that there are no significant differences between the on-campus and the remote distance groups. In the area of students' accomplishments, we found that the students performed better than their on-campus counterpart. The questionnaire shown in the appendix did not include any question that would help us identify a reason for it. The quality of the questions posed by the students were better than those posed by their on campus counterparts. We assume that because of the response time constraints the students formulated their questions more carefully and with more insight.

One of the aspects that was not initially considered was the amount of time, on the part of the instructor, that it would take to answer all questions through e-mail. It was observed that during the week the questions and clarifications on assignments from the students were sporadic, however, over the weekend they increased dramatically. It was not uncommon to have 80 to 100 individual messages waiting to be answered early Saturday or Sunday mornings. This number was cut in half Monday mornings and would decrease significantly from Tuesday until Thursday. Although it was clear that the student would do most of their work during the weekend, nobody anticipated the volume and time that it would take to answer all the questions. This created some frustration on the part of the students who wanted to have their questions answered as soon as possible to maximize their efforts over the weekend. This also drove the point that the number of students could not increase to more than 25 per session without some mechanism to answer their questions promptly.

Notifications to the students that questions would be answered in a 24-hour period reduced their expectations as to how soon their questions would be answered, however, this is not an ideal mechanism to reduce the level of frustration. Another aspect that at least one of the authors (RAMT) did not anticipate was the amount of feedback that the students expected on their programming assignments. The author, accustomed to doing markings and comments directly on the hard copy assignments, was sketchy on the electronic evaluation. He did not expect that comments such as "Program is correct. It met all specifications" would be considered insufficient by the students. They wanted feedback on their programming style or cleverness of the solution. That the students were expecting this type of evaluation was not revealed until the course evaluation.

8

Desktop Video Conferencing and Internet

Corporate downsizing and increased technology in the workplace has forced many adult learners back to school. On-line instruction offers an opportunity to complete coursework independent of time and place constraints, as well as family and workplace responsibilities. The Department of Workforce Education and Development (WED) at Southern Illinois University is one of seven departments in the College of Education. The undergraduate program is designed to prepare students for positions as instructors, trainers, and support personnel in a variety of public or private settings.

The department also offers a baccalaureate degree program at sixteen off-campus locations. Flexibility is essential; the "curricula should allow for flexibility to take advantage of accelerating technological and social change". Off-campus programs offer 70 courses each semester. Courses offered on campus are scheduled both during daytime hours and in the evenings. This format allows both traditional and nontraditional students to complete coursework.

The progressive attitude of the department provides a venue for the development of several technologically innovative courses. Designed into the course were a variety of synchronous and asynchronous computer mediated communication (CMC) techniques. These techniques facilitated three types of interaction as described by Moore and Kearsley:

1. Learner -content interaction occurs when students must synthesize their own knowledge through the materials provided.
2. Learner - instructor interaction is regarded as vital to the learning process. Instructors present content, motivate students, and supply guidance. This two-way communication helps to facilitate learning
3. Learner-learner interaction helps foster a sense of community and is essential in the development of a peer group for students to allow them an opportunity to collaborate and learn from each other.

The participants were full-time employees. The Internet delivery format allowed them to access course materials and assignments from home at their convenience. The non-centralized location of the students and their varied schedules suggest that at least some of the participants would not have taken advantage of the course if it had been offered in the traditional classroom format. Plans are underway to offer the course again.

On-line course delivery allows the incorporation of various multimedia elements, which stimulate the senses. This increases the opportunity for association and retention. Two models of instructional design were used to facilitate the desired levels of association and interaction necessary for effective on-line learning.

The Instructional Systems Design (ISD) model is a systematic approach to designing instruction. A series of steps guide the instructional designer through a process of creating materials with behavior-based objectives. The standard model is comprised of five basic phases: (a) analysis, (b) design, (c) development, (d) implementation, and (e) evaluation. Audience analysis provides a description of the intended audience and their current skill levels. Broad instructional goals incorporating specific learner outcomes are identified through consultation with a subject matter expert.

The analysis phase concludes with the creation of a mission statement to define the basic size and scope of the project. During course development, the emphasis is on performance objectives, instructional strategies, and learner activities. Performance objectives are written to define specific competencies the students must attain to meet the identified instructional goals. At this point, the instructional designer develops a course content outline to define the structure of the course, the lesson content and environment, the expected competencies and the evaluation methods.

The level of interaction necessary to achieve the objectives and the available technology are considered as course development moves into the design phase. To begin the design phase, a story-board is created for each page of the on-line lesson. The story-board provides descriptions and locations of the objects appearing on each Web page, scripts for audio and written elements, and instructions for creating the pages. The evaluation phase begins with an internal review, or alpha test of the course conducted as the course is designed for delivery. Evaluation of this process takes place when the test is concluded.

Subjects selected for the pilot test will approximate the profile of the intended audience. Beta testing is conducted with the course "up and running." The course designers use this process to identify and correct course design problems. The course is ready for distribution when the performance objectives are met.

Hypermedia instruction uses video, animation, graphics, sound, and text within a node and link structure. Course structure is defined through the sequencing of links when designing Hypermedia instruction. However, the learner must decide on the navigational strategy. This strategy increases the learner's interest in the topic, as learners prefer to control their learning. Drawbacks to Hypermedia instruction include disorientation experienced by learners. Often they cannot remember the path that brought them to their current location or how to return to their original site.

Additionally, cognitive overload occurs when the learner has trouble with comprehension due to the new presentation format. This model relies on the learner's ability to decide what to do and where to go next. Sweaney, *et al.*, suggests that the hypermedia is best used with learners who want to develop an in-depth knowledge of the material. First, organize the material before placing it on the Web. Next, plan the hyperlinks to make navigation as easy as possible.

Interaction is defined by Wagner as "reciprocal events that require at least two objects and two actions". She continues to explain that instructional interaction occurs between a learner and his environment. However, for interaction to be effective, it must move learners toward the attainment of the performance objectives. Well-designed instruction with carefully planned interaction advances students toward these goals regardless of the type of technology used.

Well-designed CMC techniques provide the vehicle for effective learner interaction within the context of on-line course delivery. Harasim maintains that on-line education uses CMC to combine distance education and face-to-face instruction. However, Hirumi and Bermudez point out that a number of on-line courses are primarily text-based and lack opportunities for interaction. Text-based courses limit the learner's chance to clarify instructional objectives and explore alternative ideas within a social context.

When incorporated into on-line instruction, CMC techniques facilitate three types of interaction: learner-content interaction, learner-instructor interaction, and learner-learner interaction. A mix of these three types of interaction is most effective in facilitating learning, provided one keeps in mind the strengths and limitations of the technology used.

Choosing the appropriate delivery medium to enhance the interaction with the use of available technology is the key to successful interaction. However, for the interaction to be truly effective, a skilled facilitator must guide it. It is important to provide an environment in which the learner can interact not only with the course content, but with other people as well. The learner-centered approach of on-line discussion requires that everyone involved share responsibility for teaching and learning. The following discussion relates how the CMC techniques pertain to the three types of learner interaction.

On-line learners are often separated by geography and time constraints. A carefully designed mixture of synchronous and asynchronous CMC techniques including videoconferencing and audio conferencing will address a variety of learning styles. It also provides the level of interactivity needed to develop a sense of community among students and the instructor/facilitator. Paulsen outlines four paradigms of CMC: (a) information retrieval or one-alone techniques, (b) e-mail or one-to-one techniques, (c) bulletin boards or one-to-many techniques, and (d) computer conferencing or many to many techniques. One-alone techniques primarily focus on the development of "self-directed learning." Information is primarily accessed through e-mail, computer conferencing, databases, and on-line journals.

One-to-one techniques typically use e-mail for learner-learner, and learner-instructor interaction when communication is best accomplished by written text. In addition, one-to-many text-based techniques typically use bulletin board systems, list-servs, and news groups. These techniques are asynchronous in nature and free of rigid time constraints. Alternatively, the many-to- many-techniques or synchronous CMC, includes project groups, conferencing, discussion groups, chatrooms, videoconferencing, and audio conferencing. The use of these techniques highlight the ability of the computer to provide and strengthen the types of interaction that occur in a traditional classroom setting.

There are some problems inherent in the use of technology to facilitate CMC. Rohfeld and Heimstra identified five hazards one might encounter:

1. The use of text-based communication can hinder those who use visual cues to understand what is being communicated. The instructor should build in assignments to facilitate informal discussion among learners to develop a feeling of interactive communication.
2. If the course is lacking in face-to-face communication, it may hinder the development of group identity and solidarity. If a face-to-face meeting is not physically or virtually possible, the instructor can compensate by designing dyadic partner assignments or small group assignments into the instruction.
3. Some students miss the spontaneity of classroom discussion. The asynchronous method of communi-

cation can cause a single discussion to extend over a long period. Students may also have a difficult time learning where to post correspondence or send assignments.

4. Learners enter the course with varying degrees of computer competency. The instructor must have a system in place to provide the extra support needed early on in the session.
5. Software used to access course materials varies widely and this influences the amount of support needed for users. It can also have an effect on the level of discussion and interaction that takes place.

The Role of the On-line Instructor The role of the on-line instructor is to model effective teaching and communication techniques.

There are four necessary conditions for successful on-line teaching: (a) pedagogical, the duties of an on-line educational facilitator, (b) social, promoting human relationships and creating a friendly environment; (c) managerial, setting the agenda, objectives and procedural rules; and (d) technical making participants comfortable with the system and software. The goal is to make the technology transparent to the learner. The on-line instructor needs to be a flexible, patient individual who will take the steps necessary to build the confidence and competence of the learners.

The WED on-line course server hosts the department's on-line courses. Students select one of three courses listed on the homepage. After selecting the ISD course, students find themselves at the Computer Gateway Interface (CGI) access page. From here, there is access to the syllabus and course outline. Entry to course materials requires an identification number and password. The server software provides the password protection and a CGI script records the access time and date into a log. The ISD course home page features a "virtual" office. Through this interactive graphic, students may access a class e-mail list, chatroom, bulletin board, references, dates and deadlines page, and the links found in the eight units. Students were also issued a course workbook, tutorial manual, and the ISD software to install on a computer.

E-mail was initially used for communication during the week preceding the initial class meeting. Students were notified of their identification number, password, and the course Uniform Resource Locator (URL) after receiving the course materials. The course was delivered in an eight-week format. Various synchronous and asynchronous CMC techniques were incorporated into the weekly assignments and activities. This provided students with structured, routine communication with other class members and the instructor.

The CMC activities also help keep coursework on schedule. Synchronous and asynchronous activities allow students to better fit the coursework into a busy life of work, school, and family as they are only occasionally required to be available at a specific time. A video/teleconferencing session scheduled for the first evening was a popular event. Integrated Services Digital Network (ISDN) access is not widely available in the rural areas of the nation, so teleconferencing was substituted where necessary. Students were pleased with this activity as it offered a human touch often absent from on-line coursework.

The synchronous activities, conferences and chatroom, were scheduled on a biweekly format. This gave students an opportunity to address questions and feel part of a group. These activities served to help students keep up their motivation levels. CMC techniques are important for creating learner-instructor and learner-learner interaction.

Delivering an on-line course increases instructor preparation time. In this instance, students were geographically dispersed within three time zones and planning the synchronous activities required careful consideration. Materials were distributed well ahead of the first session so students had the time to configure software and gain familiarity with the Internet and e-mail services. During the first two weeks, technical difficulties were experienced by virtually everyone. E-mail proved to be a very difficult concept when attachments, replies, and forwards were included in the assignments. Troubleshooting was primarily dealt with through e-mail, however a few problems required a telephone conversation.

Many of the difficulties experienced were due to students' varying levels of computer literacy. A computer/Internet pre-course test is under development to prevent this problem in the future. It is essential that the instructor stick to the agenda despite these difficulties. Students tend to feel discouraged and lose motivation due to the technical problems and the new delivery format. It is particularly important to keep in touch with the students through e-mail messages containing encouragement and information. These messages were essential in facilitating participation.

9

Interactive Technical Documentation

Today's technical documentation confronts the problem of handling a great deal of data in an integrated environment: working orders, diagrams, spare part figures, pricing lists, diagnostic reports, services bulletins, and so on. Therefore, hypertext principles for management of information are of special importance in a technical context, because they allow engineers and technicians to access large amounts of textual and visual data in an associative fashion.

Many concepts for providing technical support are visual or structural, and reasoning in these situations demands almost an immediate access to visual information. Multimedia systems rely on a high degree of interactivity, and heavily exploit visual metaphors such as graphics and icons. Therefore, these features of multimedia systems need to be highly exploited when designing systems which provide technical support. Many corporations are trying to find alternative ways to work with technical documentation due to the huge volume of paper technical manuals require to operate and maintain today's equipment.

In addition, other factors including the life cycle of preparation, maintenance, updating, applicability to the intended using population, and logistical support, led people in the industry to look for new solutions to these problems. Thus, it can be mentioned that the main factors related to the problem with technical documentation are :

- Paper volume
- Production cost
- Distribution channels
- Information structure
- Multiple languages
- It is produced at different departments
- It is distributed in different ways
- Several target groups and a great diversity of users
- Creation of training material

Multimedia systems are interesting for training and education due to three main characteristics:

1) multi-channel communication;
2) the huge quantity of learning material which can be integrated in them;
3) the access facilities to the learning material.

These characteristics explain why industrial training is a particularly appropriate arena for the use of interactive multimedia systems as an adjunct to traditional teaching and training methods.

The enormous volume of diverse information technicians are expected to acquire is constantly expanding and changing. Many of these concepts are visual or structural. Therefore teaching and learning is enhanced when visualization, motion, and text are synchronized into one source of knowledge and computing power is used to transform passive learning into interactive, dynamic learning. Most importantly, this gives the option to personalize the style of studying and to make it more appropriate and effective. Thus, computer based interactive media technology plays an important role in performance support and industrial training, because it represents an alternative way in which human knowledge can be described and transferred, exploiting all the capabilities of human performance in handling and processing information.

In March 1996, the Department of Applied Multimedia at the Institute for Media Technology (IMT) launched an interactive multimedia project called Interactive Manuals. Four major Swedish multinational corporations have participated in this project. This project has been sponsored by the Swedish National Board for Industrial and Technical Development (NUTEK), and part of the Industrial Research of Applied Multimedia program carried out by our institution between 1995 and 1997. The objectives of the IMAN project have been; first, to review and analyze the problem of producing, designing, distributing and using technical documentation and second, to develop a computer-based architecture for the implementation of interactive technical documentation using multimedia technology.

In order to achieve these goals we have developed an interactive multimedia system which presents, stores, retrieves, and transmits audio, video, graphic, and textual information. These kinds of systems can have a powerful impact on the learner's problem solving abilities which can generate a positive effect for the corporation. The development of computer —assisted interactive multimedia technology appears to be a major breakthrough for industrial training and performance support.

The selection of the appropriate technical information and the time required to provide customer support is a domain where most of the service engineers (SE) from the participating companies at the IMAN project wanted to improve. Task analysis techniques have been applied to recognize the importance of the user. We used this knowledge to collect information about how different tasks are performed. Based on this knowledge we have defined a set of demands that a computer-based support system must fulfill to overcome some of the difficulties presented in section 1. In order to make more effective the flow of information, the system must be designed to meet these demands. The resources used in this stage include personal contact with the different people at the four corporations. Below we describe some of these requisites:

One aim with the design of the multimedia system is to improve and make more effective actual working procedures with regard to:

a. Presenting and searching for information contained in the instruction manuals and spare parts catalogues

b. Electronic exchange of technical information (article numbers, price list, and so on)

c. Reducing training costs

To provide technical support and assistance, SE and after sales staff are particularly dependent on the availability of relevant image material in the form of CAD diagrams, and spare parts figures. This material must be easily accessible and manageable in a form which corresponds to their individual needs. They must be provided with means for a simultaneous display of images, different levels of zooming, as well as electronic ways for the exchange of information.

SE and after sales staff need familiar and natural ways to interact with computers that do not interfere with individual concentration or the immediate task of assisting the client. Special regard must be given to the design of the user interface, which needs to be based on the knowledge of the work situation. To build a system with the characteristics mentioned above, we decided to use hypermedia techniques. Hypermedia techniques will be responsible for the communication between the user and the computer system in order to transfer technical "knowledge" to the final users. In this approach the domain specific knowledge is represented by a structured collection of knowledge objects. In the simplest form a knowledge object consists of:

- a fact
- a production rule
- a written or spoken text
- a digitalized soundclip
- an image
- a videoclip etc.

Complex knowledge objects are more or less dynamic structures of objects. The objects are designed in such a way that they can be used as building blocks for the construction of various utilities such as :

- performance support systems
- multimedia presentations
- video-or hypermedia programs for customer's training

One of the main features of this approach is that the refuse of domain specific knowledge objects preserves the consistency of the knowledge comprised and used by all applications. This is especially important with regard to the requirement for a continuous updating of the utilities by new or improved information. It is difficult to define a set of guidelines for the design of human computer interfaces in the industry. Today's industry makes this task almost impossible due to the diversity and different tasks which technicians and engineers must perform in every specialty. The goal is to computerize the correct functions in an effective way, following a set of design criteria for the construction of successful systems. Thus, a major concern in the design of the user interface was that the communication with the user must be simple and effective. The main reason in using hypermedia to build the user interface was the need to integrate text, images, animations and videoclips.

10

Computer Literacy Courses

Computer competency has been considered a prerequisite for success in many college programs and careers. Consequently, high schools and even elementary schools have introduced courses specifically designed to develop or enhance students~ computer capabilities Students are also much more likely to have access to personal computers at home. In sum, college-bound students are increasingly likely to possess a significant amount of computing experience. Accordingly, students entering college today are expected to be more computer literate than their counterparts in years past. Therefore, if students "bring to class" the basic computer knowledge and skills regularly taught in introductory courses, then the novice-level training approach typically employed in such courses may not be appropriate. In fact, the course itself may be unnecessary.

On the other hand, if computer experience acquired prior to matriculation does not encompass the basic computer skills necessary for effective computer use in college courses, students may become discouraged and even avoid computer use. Students lacking sound computer fundamentals may find it difficult to subsequently acquire more sophisticated computer skills. As collegiate programs increasingly involve computer-based content, the academic performance of "experienced but insufficiently prepared" students may suffer. Therefore, assumptions made regarding the linkage of prior computer experience to actual computer literacy should be examined with care. These assumptions have important implications for the scope and orientation of introductory computer literacy courses.

Previous research has provided limited and sometimes puzzling findings regarding the relationship of prior computer experience to computer literacy. For example, Brock et al. found that nearly any type of computer experience, especially video game experience, increased the computer literacy levels of incoming students to some degree. Surprisingly, however, exposure to computer information systems at the high school or community college level was found to have little significant impact on student computer literacy.

In general, entering students failed to exhibit levels of computer literacy that were equivalent to students who had completed an introduction to management information systems (MIS) course. Brock et al. characterized these findings as preliminary and called for additional research into the relationship between computer experience and computer literacy. In answering this call, we have taken what we suggest is a logical next step by including a measure of computer-dependent course performance in our research. However, a review of the literature in this research context revealed no studies employing actual measures of course performance.

Researchers have been concerned with the relationship of factors such as attitudes about computers or computer exposure to computer literacy and the impact of attitudes on computer performance . No studies were apparent that examined the relationships among all three factors of interest: prior computer experience, computer literacy, and computer-dependent course performance. Our literature review also revealed considerable disagreement about the definition and measurement of computer literacy. For reasons discussed in subsequent sections of this article, we chose to operationalize computer literacy using a measure of computer self-efficacy (CSE) originally developed by Murphy, Coover, and Owen.

Although subjective measures may be more vulnerable to certain types of error than objective measures, the CSE scale is a self-report measure of perceived computer literacy that has been demonstrated to be high in reliability and validity, Moreover, prior research has successfully employed the CSE scale as an informative indicator of computer skill. Consequently, this study was designed to enhance our understanding of the relationship between prior computer experience and student perceptions of computer literacy (i.e., CSE), as well as the relationship of prior computer experience to computer-dependent course performance in an introductory MIS course. This study differs from prior research in several important ways.

We employed a subjective measure of computer literacy based on the well-researched construct of self-efficacy. Second, changes in student perceptions of computer literacy were measured within subjects as opposed to between groups to control for variability because of individual differences. Finally, this study also employed an objective measure of computer- dependent course performance. This article is organized as follows. Given the consistent research concern regarding the definition and measurement of computer literacy, the relationship of CSE to computer literacy is discussed first. Second, our research methodology is presented, including the study sample, measures, procedures, and data analysis. Results and discussion follow. Conclusions, study limitations, and directions for future research complete the article.

A review of the educational computing literature reveals considerable frustration and little agreement about the definition of computer literacy. Rather than develop an original measure, we employed the CSE scale, a subjective measure of computer literacy that has been tested, validated, and described as high in reliability and validity. The CSE scale has been used as a subjective measure of computer literacy in similar computer training circumstances. CSE has been defined as "a judgment of one's ability to use a computer".

Prior research indicates that CSE is positively correlated with willingness to choose and participate in computer activities, expectations of success, persistence when faced with computer- related difficulties, and computer-related performance. In sum, CSE is an intuitively appealing construct that appears to capture the combined sense of computer competence and confidence, which in large part define the characteristics of individuals deemed to be computer literate. Moreover, prior CSE research in other computer training settings has suggested interesting relationships among the variables of particular interest in this study. For example, actual experience with computers has been shown to enhance an individual's personal sense of self-efficacy with computers.

A positive relationship between computer experience and computer performance is posited to occur only when that experience directly impacts computer self-efficacy. In other words, although an individual might have substantial computer experience, computer experience per se does not guarantee successful performance with a computer. Such a finding is intuitive and is supported both by our practical experience as instructors of introductory MIS courses and by the results of a recent survey of students entering a midwestern U.S. university.

Although incoming students are more likely-to have computer experience and perceive themselves as computer literate, that experience is often narrow in scope and is not necessarily predictive of a desire to learn about or use computers. CSE has the practical advantage of lending itself to measurement. Although previous CSE research has employed scales of varying length, it is most critical that the specific skills of interest be accurately and unambiguously identified. Consequently, we selected the CSE scale originally developed by Murphy et al. Those scale items most closely reflect the skills taught in introductory MIS courses.

In addition to being successfully employed as a subjective measure of computer literacy in other research, the CSE scale has been successful in detecting changes in computer self-efficacy over time. Any measure designed to capture computer literacy has weaknesses, serving at best as an approximation of an individual's actual computer literacy. The CSE measure employed in this study assesses self-perceptions of computer skills rather than the skills themselves.

Perceptual measures may be subject to more error than comparable objective measures of computer literacy, but prior research has demonstrated a significant, positive correlation between the CSE scale employed here and an objective measure of similar skills. Bearing the limitations of subjective measures in mind, however, the insights offered by prior CSE research regarding the targeted variables here support the use of CSE as an appropriate and potentially enlightening subjective measure of computer literacy in this research context.

Research subjects consisted of 98 undergraduate students enrolled in a required introduction to information systems course at a university in the midwestern United States. Although approximately 300 students enroll in the course each semester, the sample was limited to students in sections taught by the same instructor to avoid instructional method bias. Participation in the study was optional, and confidentiality was guaranteed. No students opted not to participate. Because data collection did require temporary identification of the subjects, data analysis was delayed until after grades were assigned.

An initial questionnaire was administered the first day of class, prior to any computer training. The questionnaire collected standard demographic data, as well as three separate measures of self-reported computer experience that have been associated with computer literacy in prior research: total years of computer experience (COMPEX), current average hours per week of computer use (COMPUSE), and the number of prior computer courses completed (COURSES). As mentioned, student perceptions of computer literacy were collected through the 35 item, 5-point Likert-type CSE scale. This scale was slightly modified to include skills associated with working in a networked environment, a change appropriate for this course.

Students had to understand, distinguish between, and navigate among resources on their local workstation, LAN server, course Web server, and campus mainframe. Therefore, several items were added to the CSE scale to assess students' self- perceptions of their skills in such an environment. Aggregate scores on the scale, with a potential range of 35 to 175 points, were calculated, with a higher score indicating a higher level of CSE. Course content and structure were typical of introductory MIS courses currently offered in business schools. The course provided students an opportunity to develop or enhance their knowledge of and hands-on facility with appropriate computer hardware and software in a networked environment.

A laboratory portion of the class was integrated with lecture sessions and provided at least 15 semester hours of hands-on experience with microcomputer applications, including operating systems, programming, spreadsheet analysis, and database management software. The CSE scale was administered again the last regular day of class. In addition, an objective measure of computer-dependent course performance was obtained.

The objective performance measure (PERFORMANCE) was the sum of the points earned on nine computer-based homework assignments given throughout the semester. Homework assignments required students to understand and apply an operating system, a spreadsheet, a third-generation programming language, and a relational database to solve various business-related problems. Each assignment generally required 2-4 hours to complete. The instructor who graded the assignments was unaware of student computer experience levels or CSE scores.

Preliminary data analysis indicated no significant interactions or unexpected relationships among the demographic factors and the target research variables other than those of interest in the study. This may be attributable to the fact that the study sample predominantly consisted of traditional students. Although the homogeneity of the sample limits the generalizability of study results, it did permit a less cluttered examination of the primary study variables. Basic correlation analysis and multiple regression were used to determine the significance and direction of the relationships among the study variables. At test analysis was used to detect changes in precourse and postcourse measures of computer self-efficacy. Reported years of prior computer experience ranged from 0 to 14, M = 2.6 years, SD = 2.83. Average hours per week of computer use ranged from 0 to 50, M = 5.95, SD = 8.03, and the number of prior computer courses completed ranged from 0 to 11, with the average student indicating that he or she had taken at least one previous course.

Scores on the precourse measure of CSE ranged from 67 to 175, M = 118.73, SD 21.98. By contrast, scores on postcourse CSE ranged from 116 to 175, M 153.60, SD = 14.97. Only one student on the precourse CSE and three students on the postcourse CSE scored the maximum (175) points available, alleviating our concern about a possible ceiling effect.

A large proportion of students scoring the maximum on the precourse CSE measure might indicate that the measure employed was inappropriate or that incoming students did indeed possess the computer skills normally imparted at the introductory course level. If most students had attained the maximum score on the postcourse measure, interpretation would have been more difficult. As for the measure of performance, total scores on the computer-dependent course assignments ranged from 49.50 to 70, M = 63.5, SD = 4.98. The nature of these scores is discussed in more depth below.

The number of prior courses taken and years of prior computer experience are significantly and positively correlated, r = .29 10, p < .0 1. Interestingly, no significant relationship was found between prior coursework and current computer usage. Finally, all three measures of computer experience are significantly and positively correlated with the precourse CSE scores, COMPEX, r =.3368, P <.01; COMPUSE, r =.4864, P <.01; and COURSES, r =.4472, P <.01.

The results support the findings of Hill et al. (1987) that actual computer experience should enhance one's personal self-efficacy with computers and of other research that has found multiple types of computer exposure to be significantly related to student computer literacy levels. Interestingly, all three computer experience measures are correlated with CSE, yet only CSE, $r = .3182$, $p < .01$, and COMPUSE, $r = .2727$, $p < .01$, are significantly related to PERFORMANCE (see Table 1).

A multiple regression analysis was conducted to better understand the relationship of the three experience measures and CSE to PERFORMANCE. Both stepwise and hierarchical analyses confirmed the model shown in Table 2. Notably, none of the three measures of computer experience, whether entered individually or as a set in the supplementary hierarchical analysis, were significant predictors of PERFORMANCE. Table 2 demonstrates that precourse CSE, however, was significantly related to PERFORMANCE, $P < .05$. These results are consistent with prior CSE research findings that only experiences directly influencing personal self-efficacy beliefs are likely to impact performance.

In other words, although computer experience in general may contribute to perceived computer literacy, only those aspects of the experiences directly relevant to the development of the computer skills defined to constitute computer literacy seem to matter. For example, the CSE scale employed here was selected because it includes the basic computer skills most introductory MIS courses seek to provide. Today's students may accumulate a great deal of computer experience prior to college entry. However, this type of experience may provide a computer literacy that does not encompass the specific computer skills deemed necessary for success at the college level. These results also appear to be in line with the findings of Taylor and Mounfield regarding success factors in college computer science courses. Taylor and Mounfield found it was the kind of programming experience high school students had rather than programming experience per se that was most indicative of success in college-level computer science courses. It should also be noted that although the positive correlation between CSE and computer-dependent course performance was significant, it was not particularly high. To some extent, we believe chat the particular nature of the CSE measure, and the unique requirements of this particular introductory MIS course, may have "muted' the strength of this relationship.

Although the CSE measure most closely measured the skills taught in the course, the computer assignments forming the basis of the performance measure did require analysis and problem-solving skills that are unlikely to have been captured by the measure. In addition, in this course, if students submitted an unsatisfactory computer-dependent assignment (e.g., they received less than 70% of the points available for the exercise), they were required to resubmit the assignment in satisfactory form.

Although students received only the points awarded when an assignment was originally submitted, a side effect of this policy is that students were "forced" to become more computer competent during the course. Although this is a desirable outcome from an instructional point of view, this policy may have weakened the observed relationship between CSE and performance. Finally, in order to assess the relevance of course content and training level to the student perceptions of computer literacy levels, the CSE measure was administered upon course completion.

There was a significant difference in precourse CSE, overall $M = 118.73$, overall $SD = 21.98$, per item $M = 3.39$, per item $SD = .63$, and postcourse CSE, overall $M = 15$

3.60, overall *SD = 4.97,* per item *M = 4.39,* per item SD = .41,p < .001. Student perceptions of their computer capabilities were positively enhanced during the semester, supporting previous findings in similar training settings. Given that the CSE scale items closely reflect the basic skills and concepts conveyed in this and similar computer literacy courses, it suggests that both training content and instructional level were necessary and appropriate for the group as a whole.

Index

Accounting management, 215
Action control, 112
American Society of Training and Development (ASTD), 134
Assignment mode, 87
Audience profile, 21

Business Process Management, 13

Capital investment Appraisal, 88
CD-ROM, 100
Cognitive chaos, 111
Communication technology, 1
Computer Supported Collaborative Learning systems, 2
Computer-assisted instruction, 114
Configuration management
Continuous Professional Development, 34

Electronic Performance Support Systems, 2
E-mail, 94
Exosystem, 75

Fault management, 215
Fax communication, 64

Giant button, 70
Group Decision Support Systems (GDSS), 3

Hewlett-Packard, 151
Higher education, 77
Home page, 95
Horizontal integration, 82
Human development, 73
Hydraulic actuator, 103
Hydraulic fluids, 103
Hydraulic pumps, 103
Hydraulic systems, 103

Instructional system design, 101
Intelligent tutoring system, 78
Intelligent tutoring tool, 82
Interactive Distance Learning, 54
Interactive mode, 86
Interactive multimedia, 98
Internet education, 139

Key skills, 37

Lansing Community College (LCC), 46
Learning Technology Programme, 79
Local area networks, 146

Macrosystem, 75

Management information base, 211
Marginal costing, 80
Mass education, 1
Media mix, 130
Mesosystem, 75
Microsystem, 75
Multimedia, 78
Multi-User Dungeon, 153Internet Assigned Numbers Authority (IANA), 155
Multi-User-Dimension, 153

National Record of Achievement (NRA), 32
National Science Foundation, 91

Perceptual learning theory, 131
Performance Learning Systems (PLS), 137
Performance management, 215
Project description, 21
Project scope, 21

Quality management, 11

Ready-made knowledge, 2
Repertoire knowledge, 213

Security management, 215
Serial Line Internet Protocol (SLIP), 156
Structured Sound Function (SSF), 123
Subject matter expert, 132

Teaching Support Tools (TSTs), 89

Usability testing, 25
Usenet, 152

Virtual learning, 18

Web-based instruction, 41
Web-based training, 21
Web-delivered information, 52
Wide area networks, 146
World Wide Web, 4

Dr. S. Venkataiah received his education from Osmania University, Hyderabad. Having brilliant academic career, winning honours and awards in India and abroad, Dr. Venkataiah is the author of many scientific papers published in reputed national as well as Foreign periodicals.

He has been writing on curriculum development and its allied issues for last fifteen years. As an academician his contribution in the field of education is widely acclaimed.

He has authored/edited a number of outstanding books in his areas of specialisation.

Rs. 700

Some More Relevant Books

- Educational Technology and Conceptual Understanding
  —*Agarwal, Rashmi*
- Encyclopaedic Dictionary of Psychology (Set of 4 Vols.)
  —*Bhagi, Manjula & Sunita Sharma*
- Encyclopaedia of Child Psychology and Development
  (Set of 8 Vols.) —*Dutt, Suresh*
- The Interpretation of Dreams
  —*Freud, Sigmund*
- Encyclopaedia of Modern Educational Thought (5 Vols.)
  —*Gupta, N.L.*
- Encyclopaedia of Educational Problems (Set of 2 Vols.)
  —*Hall, G.S.*
- Encyclopaedia of Educational Learning and Teaching Technology
  (Set of 30 Vols.) —*Kaushik, Vijaya Kumari*
- Encyclopaedia of Educational Development & Planning
  (Set of 5 Vols.)
  —*Laxmi Devi*
- Encyclopaedia of Educational Research Methodology
  (Set of 3 Vols.) —*Nagpal, Shakuntla*
- Encyclopaedia of Child Development (Set of 5 Vols.)
  —*Nanda, V.K.*
- Encyclopaedia of Modern Methods of Teaching and Learning
  (Set of 5 Vols.) — *Rao, V.K.*
- Encyclopaedia of Modern Educational Research (10 Vols.)
  —*Sharma, S.R.*
- Encyclopaedia of Teaching Languages in India (Set of 35 Vols.)
  —*Sharma, S.R.*
- Encyclopaedia of Educational Technology (Set of 15 Vols.)
  —*Sharma, Sita Ram, et al.*
- Encyclopaedia of Statistics, Psychology and Education
  (Set of 4 Vols.) —*Sinha, B.L.*
- Encyclopaedia of Comparative Education (Set of 5 Vols.)
  —*Taneja, R.P.*
- Perspectives in Measurement Evaluation in Education
  (Set of 5 Vols.) — *Vashist, S.R.*

ANMOL PUBLICATIONS PVT. LTD.
4374/4B, ANSARI ROAD, DARYA GANJ,
NEW DELHI-110 002 (INDIA)